OHTAC Recommendation

Physiotherapy Rehabilitation after Total Knee or Hip Replacement

June 17, 2005

OHTAC Ontario Health Technology Advisory Committee

Ontario

Physiotherapy Rehabilitation after Total Knee or Hip Replacement

The Ontario Health Technology Advisory Committee (OHTAC) met on June 17, 2005 and reviewed the health technology policy assessment on physiotherapy services after total knee or hip replacement.

OHTAC Findings:

A systematic review of the scientific literature was completed by the Medical Advisory Secretariat to determine the effectiveness of three physiotherapy interventions on physical functioning 1 year after primary total hip or knee replacement surgery:

1. Home-based physiotherapy compared with inpatient physiotherapy.
2. Clinic-based physiotherapy compared with self-managed home exercises.
3. Preoperative exercise program compared with no preoperative exercise.

Based on one large randomized controlled trial of high quality there is no advantage to receiving inpatient physiotherapy compared with a home-based physiotherapy program for primary total hip or knee replacement patients.

Based on one large randomized controlled trial of low to moderate quality there is no advantage to attending an outpatient physiotherapy clinic and practicing a self managed home exercise program when compared with practicing a self managed home exercise program and receiving supportive/monitoring phone calls from a physiotherapist for primary total hip or knee replacement patients.

Based on one large randomized controlled trial of moderate quality there is no advantage of an exercise program beginning 4-6 weeks before primary total knee replacement on physical functioning after surgery.

Physiotherapy Rehabilitation after Total Knee or Hip Replacement

Based on one small, randomized controlled trial of moderate quality there is limited advantage of an exercise program beginning 8 weeks before primary total hip replacement.

OHTAC Recommendations:

1. The health system should support the move towards home-based physiotherapy after primary total knee or hip replacement and discharge from acute care. Current initiatives that are underway in the province to improve allocation of physiotherapy services for primary hip and knee replacement patients should be supported by the health care system.

2. For patients who could attend an outpatient physiotherapy clinic consideration may be given to a self-managed home exercise program with a physiotherapist monitoring through phone calls.

3. The full benefit of a preoperative exercise program is not as yet realized.

These recommendations are made to Ontario hospitals and community services with the relevant expertise. They will be communicated to the hospitals and rehabilitation service providers through their posting on OHTAC's website and the distribution of OHTAC's E-bulletin.

Physiotherapy Rehabilitation After Total Knee or Hip Replacement

Health Technology Literature Review

Completed June 2005

Ontario

Disclaimer

This health technology scientific literature and policy review was prepared by the Medical Advisory Secretariat, Ontario Ministry of Health and Long-Term Care, for the Ontario Health Technology Advisory Committee and developed from analysis, interpretation, and comparison of scientific research and/or technology assessments conducted by other organizations. It also incorporates, when available, Ontario data, and information provided by experts and applicants to the Medical Advisory Secretariat to inform the analysis. While every effort has been made to do so, this document may not fully reflect all scientific research available. Additionally, other relevant scientific findings may have been reported since completion of the review.

Please contact MASInfo@moh.gov.on.ca if you are aware of scientific research findings that should inform the report or would like further information.

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Executive Summary

Purpose

The purpose of this health technology policy analysis was to determine, where, how, and when physiotherapy services are best delivered to optimize functional outcomes for patients after they undergo primary (first-time) total hip replacement or total knee replacement, and to determine the Ontario-specific economic impact of the best delivery strategy. The objectives of the systematic review were as follows:

- To determine the effectiveness of inpatient physiotherapy after discharge from an acute care hospital compared with outpatient physiotherapy delivered in either a clinic-based or home-based setting for primary total joint replacement patients
- To determine the effectiveness of outpatient physiotherapy delivered by a physiotherapist in either a clinic-based or home-based setting in addition to a home exercise program compared with a home exercise program alone for primary total joint replacement patients
- To determine the effectiveness of preoperative exercise for people who are scheduled to receive primary total knee or hip replacement surgery

Clinical Need

Total hip replacements and total knee replacements are among the most commonly performed surgical procedures in Ontario. Physiotherapy rehabilitation after first-time total hip or knee replacement surgery is accepted as the standard and essential treatment. The aim is to maximize a person's functionality and independence and minimize complications such as hip dislocation (for hip replacements), wound infection, deep vein thrombosis, and pulmonary embolism.

The Therapy

The physiotherapy rehabilitation routine has 4 components: therapeutic exercise, transfer training, gait training, and instruction in the activities of daily living. Physiotherapy rehabilitation for people who have had total joint replacement surgery varies in where, how, and when it is delivered. In Ontario, after discharge from an acute care hospital, people who have had a primary total knee or hip replacement may receive inpatient or outpatient physiotherapy. Inpatient physiotherapy is delivered in a rehabilitation hospital or specialized hospital unit. Outpatient physiotherapy is done either in an outpatient clinic (clinic-based) or in the person's home (home-based). Home-based physiotherapy may include practising an exercise program at home with or without supplemental support from a physiotherapist.

Finally, physiotherapy rehabilitation may be administered at several points after surgery, including immediately postoperatively (within the first 5 days) and in the early recovery period (within the first 3 months) after discharge. There is a growing interest in whether physiotherapy should start before surgery. A variety of practices exist, and evidence regarding the optimal pre- and post-acute course of rehabilitation to obtain the best outcomes is needed.

Review Strategy

The Medical Advisory Secretariat used its standard search strategy, which included searching the databases of Ovid MEDLINE, CINHAL, EMBASE, Cochrane Database of Systematic Reviews, and PEDro from 1995 to 2005. English-language articles including systematic reviews, randomized controlled trials (RCTs), non-RCTs, and studies with a sample size of greater than 10 patients were included. Studies

had to include patients undergoing primary total hip or total knee replacement, aged 18 years of age or older, and they had to have investigated one of the following comparisons: inpatient rehabilitation versus outpatient (clinic- or home-based therapy) rehabilitation, land-based post-acute care physiotherapy delivered by a physiotherapist compared with patient self-administered exercise and a land-based exercise program before surgery. The primary outcome was postoperative physical functioning. Secondary outcomes included the patient's assessment of therapeutic effect (overall improvement), perceived pain intensity, health services utilization, treatment side effects, and adverse events

The quality of the methods of the included studies was assessed using the criteria outlined in the Cochrane Musculoskeletal Injuries Group Quality Assessment Tool. After this, a summary of the biases threatening study validity was determined. Four methodological biases were considered: selection bias, performance bias, attrition bias, and detection bias. A meta-analysis was conducted when adequate data were available from 2 or more studies and where there was no statistical or clinical heterogeneity among studies. The GRADE system was used to summarize the overall quality of evidence.

Summary of Findings

The search yielded 422 citations; of these, 12 were included in the review including 10 primary studies (9 RCTs, 1 non-RCT) and 2 systematic reviews.

The Medical Advisory Secretariat review included 2 primary studies (N = 334) that examined the effectiveness of an inpatient physiotherapy rehabilitation program compared with an outpatient home-based physiotherapy program on functional outcomes after total knee or hip replacement surgery. One study, available only as an abstract, found no difference in functional outcome at 1 year after surgery (TKR or THR) between the treatments. The other study was an observational study that found that patients who are younger than 71 years of age on average, who do not live alone, and who do not have comorbid illnesses recover adequate function with outpatient home-based physiotherapy. However results were only measured up to 3 months after surgery, and the outcome measure they used is not considered the best one for physical functioning.

Three primary studies (N = 360) were reviewed that tested the effectiveness of outpatient home-based or clinic-based physiotherapy in addition to a self-administered home exercise program, compared with a self-administered exercise program only or in addition to using another therapy (phone calls or continuous passive movement), on postoperative physical functioning after primary TKR surgery. Two of the studies reported no difference in change from baseline in flexion range of motion between those patients receiving outpatient or home-based physiotherapy and doing a home exercise program compared with patients who did a home exercise program only with or without continuous passive movement. The other study reported no difference in the Western Ontario and McMaster Osteoarthritis Index (WOMAC) scores between patients receiving clinic-based physiotherapy and practicing a home exercise program and those who received monitoring phone calls and did a home exercise program after TKR surgery.

The Medical Advisory Secretariat reviewed two systematic reviews evaluating the effects of preoperative exercise on postoperative physical functioning. One concluded that preoperative exercise is not effective in improving functional recovery or pain after TKR and any effects after THR could not be adequately determined. The other concluded that there was inconclusive evidence to determine the benefits of preoperative exercise on functional recovery after TKR. Because 2 primary studies were added to the published literature since the publication of these systematic reviews the Medical Advisory Secretariat revisited the question of effectiveness of a preoperative exercise program for patients scheduled for TKR ad THR surgery.

The Medical Advisory Secretariat also reviewed 3 primary studies (N = 184) that tested the effectiveness

of preoperative exercise beginning 4-6 weeks before surgery on postoperative outcomes after primary TKR surgery. All 3 studies reported negative findings with regard to the effectiveness of preoperative exercise to improve physical functioning after TKR surgery. However, 2 failed to show an effect of the preoperative exercise program before surgery in those patients receiving preoperative exercise. The third study did not measure functional outcome immediately before surgery in the preoperative exercise treatment group; therefore the study's authors could not document an effect of the preoperative exercise program before surgery. Regarding health services utilization, 2 of the studies did not find significant differences in either the length of the acute care hospital stay or the inpatient rehabilitation care setting between patients treated with a preoperative exercise program and those not treated. The third study did not measure health services utilization.

These results must be interpreted within the limitations and the biases of each study. Negative results do not necessarily support a lack of treatment effect but may be attributed to a type II statistical error.

Finally, the Medical Advisory Secretariat reviewed 2 primary studies (N = 136) that examined the effectiveness of preoperative exercise on postoperative functional outcomes after primary THR surgery. One study did not support the effectiveness of an exercise program beginning 8 weeks before surgery. However, results from the other did support the effectiveness of an exercise program 8 weeks before primary THR surgery on pain and functional outcomes 1 week before and 3 weeks after surgery.

Conclusions

Based on the evidence, the Medical Advisory Secretariat reached the following conclusions with respect to physiotherapy rehabilitation and physical functioning 1 year after primary TKR or THR surgery:

- There is high-quality evidence from 1 large RCT to support the use of home-based physiotherapy instead of inpatient physiotherapy after primary THR or TKR surgery.
- There is low-to-moderate quality evidence from 1 large RCT to support the conclusion that receiving a monitoring phone call from a physiotherapist and practising home exercises is comparable to receiving clinic-based physiotherapy and practising home exercises for people who have had primary TKR surgery. However, results may not be generalizable to those who have had THR surgery.
- There is moderate evidence to suggest that an exercise program beginning 4 to 6 weeks before primary TKR surgery is not effective.
- There is moderate evidence to support the effectiveness of an exercise program beginning 8 weeks before surgery to improve physical functioning 3 weeks after THR surgery.

Abbreviations

HSSK	Hospital for Special Surgery Knee (scale)
KSCRS	Knee Society Clinical Rating Scale
PT	Physiotherapy
RCT	Randomized controlled trial
ROM	Range of motion
THR	Total hip replacement
TKR	Total knee replacement
WOMAC	Western Ontario and McMaster University Osteoarthritis Index.

Issue

The purpose of this health technology policy analysis was to determine, where, how, and when physiotherapy services are best delivered to optimize functional outcomes for patients after they undergo primary (first-time) total hip replacement (THR) or total knee replacement (TKR), and to determine the Ontario-specific economic impact of the best delivery strategy.

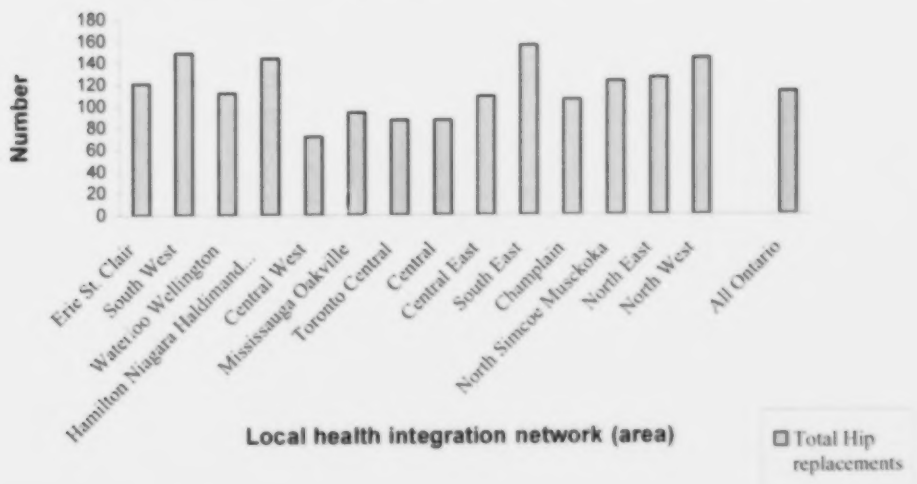
Background

Clinical Need: Target Population and Condition

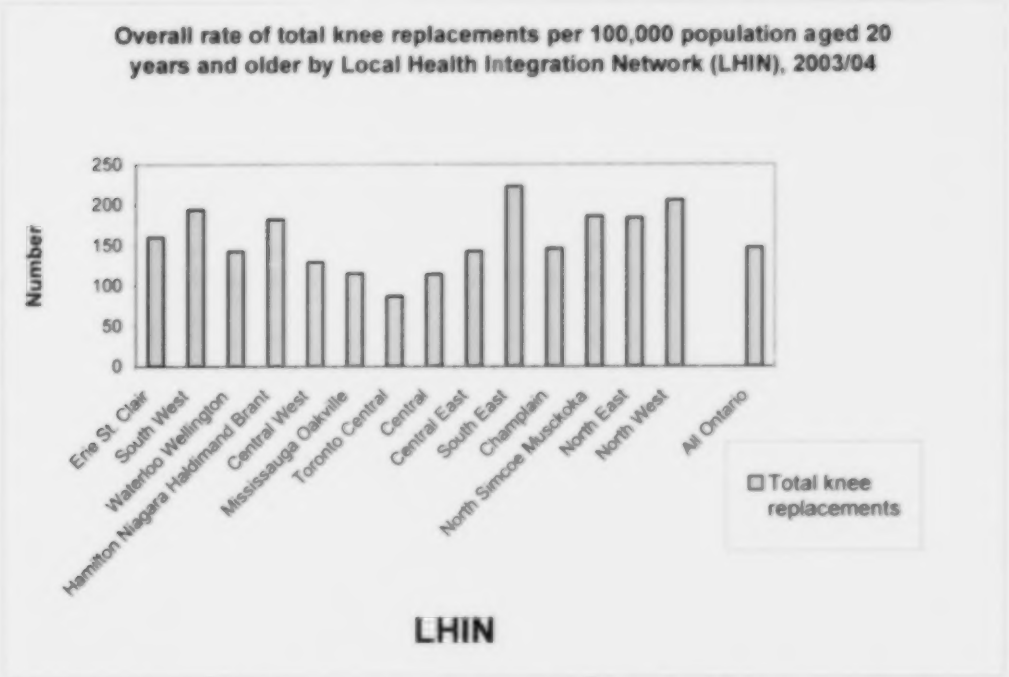
THR and TKR surgeries are 2 of the most commonly performed surgical procedures in Ontario. (1) In 2003/04 in Ontario, there were 7,372 planned primary total hip and 11,488 planned primary total knee replacement surgeries, resulting in 113 and 147 out of every 100,000 people aged over 20 years old having a total hip or knee replacement, respectively. (1) (See Figures 1 and 2.) Although the rates for THR and TKR are highest among people aged 65 to 84 years, (1) the overall rates of both procedures are increasing, as are the waiting times to receive surgery. (2) Total joint replacement is indicated for disabling hip or knee pain from advanced osteoarthritis (OA), rheumatoid arthritis, or other joint diseases when conservative measures to manage pain and physical dysfunction such as physiotherapy, medications, and joint injection treatments have failed.

In 2003/04 in Ontario, about 75% of THR surgeries and 90% of TKR surgeries were to relieve pain and functional impairment due to OA, a degenerative disease that causes changes in the articular (joint) cartilage and the hip and knee bones. (1;3) OA affects about 10% of Canadian adults.

Figure 1: Overall Rate of Total Hip Replacement per 100,000 People Aged 20 Years and Older by Local Health Integration Network, 2003/04*



*Data Source: Access to Health Services in Ontario, ICES Atlas, April 2005



*Data Source: Access to Health Services in Ontario, ICES Atlas, April 2005

New Therapy Being Reviewed: Physiotherapy Rehabilitation

The World Health Organization defines rehabilitation as "a progressive, dynamic, goal-oriented and often time-limited process, which enables an individual with impairment to identify and reach his/her optimal mental, physical, cognitive and/or social functional level." (http://www.gtarehabnetwork.ca/rehabdefinition.asp) (accessed June 30, 2005).

Physiotherapy rehabilitation after total hip or knee replacement is accepted as a standard and essential treatment. Its aim is to maximize functionality and independence and to minimize complications such as wound infection, deep vein thrombosis, pulmonary embolism, and hip dislocation (for hip replacements). The incidence of hip dislocation in the first 3 months after surgery ranges from 3.1% to 8.3% (4) and is highest between the fourth and 12th week postoperatively. (4) The incidence of deep wound infection is 0.2% to 1% in the first 3 months after total joint replacement surgery. The prevalence of deep vein thrombosis after hip replacement surgery, including asymptomatic cases detected by venography, is between 45% and 57%. The prevalence of pulmonary embolism after THR surgery ranges from 0.7% to 30% and 0.34% to 6% for fatal pulmonary embolism. (4) Early ambulation is associated with a lower incidence of symptomatic thromboembolism after hip replacement surgery and does not increase the risk of embolization in those patients diagnosed with deep vein thrombosis. (4)

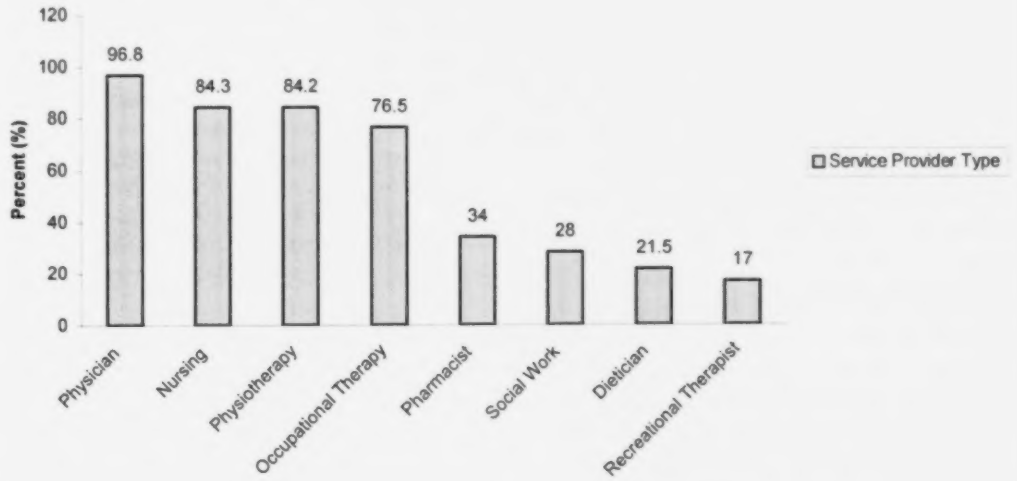
The physiotherapy rehabilitation routine has 4 components: therapeutic exercise, transfer training, gait training, and instruction in activities of daily living (ADL). (4) Ouellet and Moffet (5) report that large locomotor deficits exist 2 months after TKR surgery and that this in part supports the rationale for physiotherapy after total joint replacement. However, physiotherapy rehabilitation for total joint replacement patients varies in where, when, and how it is delivered. (6;7)

In Ontario, after discharge from the acute care hospital setting, patients who have had primary total knee or hip replacement surgery may receive physiotherapy as an inpatient or outpatient service. Inpatient physiotherapy is done in a rehabilitation hospital or specialized hospital unit. Outpatient physiotherapy is done either at an outpatient rehabilitation clinic (clinic-based) or in the patient's home (home-based). In 2001/02 in Ontario, 43.5% of people who had primary THR surgery and 42.4% of people who had primary TKR surgery were discharged to an inpatient rehabilitation service, whereas 56.5% of people who had total hip replacements and 57.6% of those who had total knee replacements were discharged directly to home. While slightly more primary total hip and knee replacement patients are being discharged to home instead of an inpatient rehabilitation facility, the proportion of patients discharged to home from acute care has decreased from about 68% in 1995/96 to 57% in 2001/02. (2)

Jaglal et al. (2) reported that in Ontario older women with comorbid conditions were more likely to be discharged to an inpatient rehabilitation facility after total hip or knee replacement surgery. During 2003/04, 84.2% of patients with unilateral hip or knee replacement surgery received physiotherapy services while in an inpatient rehabilitation facility (Figure 3).

Between 2000 and 2002 in Ontario, patients discharged to an inpatient rehabilitation facility received a mean of 6 to 7 visits of outpatient home-based rehabilitation (including physiotherapy and occupational therapy) once discharged home. Physiotherapy was the third most-requested home-based rehabilitation service after homemaking and nursing. However, since 1996, the mean number of services needed rose for homemaking and rehabilitation but fell for nursing for this population. (2)

Figure 3: Service Provider Type Related to Unilateral Hip or Knee Replacement in Ontario Rehabilitation Hospitals Based on Hospital Separations, 2003/04*



*Data Source: National Rehabilitation Reporting System Database

Similarly, between 2000 and 2002 in Ontario, patients discharged to home after surgery also received a mean of 6 to 7 visits of home-based rehabilitation therapy, which included physiotherapy and/or occupational therapy. (2) Likewise, physiotherapy was reported as the third most-requested outpatient home-based rehabilitation service after homemaking and nursing. (2) However, since 1996, the mean number of services increased for homemaking and nursing but fell slightly for rehabilitation services. (2) Mohamed et al. (8) reported that the frequency and intensity of outpatient home-based physiotherapy and occupational services provided by community care access centres (CCAC) in Ontario was variable; only 32% predetermined the duration of service.

The factors found to influence where someone will receive his or her physiotherapy after total joint replacement surgery and discharge from the acute care hospital setting include functional independence, cognitive function, age, length of stay and marital status. (9) Mahomed et al. (10) found the determinants of outpatient home-based rehabilitation included patient preference for home-based rehabilitation, male sex, and knowledge of total joint replacement care. An analysis by the Institute for Clinical Evaluative Sciences (ICES) in 2004 concluded that receiving inpatient rehabilitation in Ontario after total hip or knee replacement may depend on age, sex, comorbidity score, length of acute care hospital stay, type of surgery, and area of residence. (2)

Physiotherapy rehabilitation may be administered at several points after surgery including immediately postoperatively (within first 5 days) and in the early recovery period after discharge. It has also been suggested that physiotherapy begin before the actual hip or knee replacement surgery is done. (11) Preoperative rehabilitation, coined "prehabilitation," (11) is predicated on the theory that building muscle strength may compensate for the effects of immobilization due to hospitalization and surgery. There is also evidence that patients who have poorer functioning before surgery do not achieve as good a

postoperative functional result as those with a higher preoperative functional capacity. (11)

While a variety of practices exist, evidence regarding the optimal pre- and post-acute course of rehabilitation to obtain the best outcomes is needed. (2;9)

Measuring Effectiveness of Rehabilitation Therapy

A variety of outcome measures have been used to quantify the effects of rehabilitation interventions including joint-specific and disease-specific rating scales. Unlike the joint-specific measurements, disease-specific measurements report a more global picture of outcome from the patient's perspective. (12) Three of the most common rating scales are briefly described.

The Hospital for Special Surgery knee (HSSK) scale, and the Harris hip score (HHS) are joint-specific scoring systems. The HSSK scale was developed to measure functional assessment. It measures pain, function, and range of motion (ROM), muscle strength, flexion deformity, and instability. Scores go from 0 to 100, with 100 indicating the best health possible by summing the scores from its subcategories. (13)

The HHS was developed in 1969 to help evaluate the results of hip replacement surgery. It has become a widely used measure to compare hip pathology and results of hip replacement surgery. (14) Four areas are assessed, including pain (total score of 40), function (total score of 47), ROM (total score of 5), and absence of deformity (total score of 8). Function is subdivided into daily activities (14 points) and gait (33 points). (14) A total score is obtained by summing the scores from each of these areas. The maximum score is 100. A higher score indicates better functioning.

The Western Ontario and McMaster Osteoarthritis Index (WOMAC) is a disease-specific, self-administered, health status measure of symptoms and physical disability that was originally developed for people with OA of the hip or knee to measure changes in health status after treatment. (15) The WOMAC is considered the leading outcome measure for patients with OA of the lower extremities. (16) Evidence for the scale's test-retest reliability, validity, and responsiveness in OA patients undergoing THR or TKR and in OA patients receiving nonsteroidal antiinflammatory drugs has been reported. (15) The WOMAC has 24 questions that evaluate 3 areas: pain, stiffness, and physical function. Each question is rated using a Likert scale from 0 to 4, with lower scores indicating lower levels of health. Summing the scores of each area produces a global WOMAC score. The higher the score, the better the health status. A visual analogue scale score of the WOMAC is also available.

Although many studies use a joint-specific outcome measure, this method is thought to be incomplete and, if used, it should be combined with a global health status measure such as the WOMAC or Medical Outcomes Study Short-Form 36 (SF-36). (12)

In a prospective observational study of 684 people diagnosed with primary OA, Miner et al. (12) examined the relevance of knee ROM as an outcome measure after primary unilateral total knee replacement surgery. The mean age of the patients was 69.8 years (range, 38–90 years), and 59% were women. Miner et al. (12) reported that while patients experienced a dramatic improvement in function, as measured by the WOMAC, with a mean change in WOMAC function score of 27.1 (SD, 22.1), flexion and extension ROM only changed a little bit during the same 12 months. The mean change in flexion ROM was 2.0 degrees (SD, 17.4 degrees) and in extension ROM was 5.3 degrees (SD, 7.3 degrees). At 12 months after surgery, knee flexion ROM correlated modestly with WOMAC function scores ($r = 0.29$) and was lower than the correlation reported between the WOMAC scores and hip ROM ($r = 0.61$).

Miner et al. (12) identified 95 degrees of knee flexion as a clinically meaningful cut-off point above which ROM typically does not limit a patient's activities after TKR surgery. Patients with less than 95

degrees of flexion had significantly greater functional impairment. Miner et al. (12) concluded that when determining the success of knee replacement surgery from a patient's perspective that overall function as quantified by the WOMAC is more important than knee flexion.

Literature Review on Effectiveness

Objective

- To determine the effectiveness of inpatient physiotherapy after discharge from an acute care hospital setting compared with outpatient physiotherapy in either a clinic-based or home-based setting
- To determine the effectiveness of a patient self-administered home exercise program with or without outpatient clinic-based or home-based physiotherapy services
- To determine the effectiveness of preoperative physiotherapy for patients scheduled for primary total knee or hip replacement surgery.

Methods

Inclusion Criteria

- English-language publications
- Systematic reviews
- Randomized controlled trials (RCTs)
- Non-RCTs, including before-and-after clinical trials
- Studies with a sample size greater than 10
- Patients undergoing primary total hip or knee replacement surgery
- Aged 18 years or older

Interventions

- Inpatient rehabilitation versus outpatient (clinic- or home-based therapy)
- Land-based post acute care physiotherapy delivered by a physiotherapist compared with no physiotherapist or no treatment
- Land-based rehabilitation before surgery

Outcome Measures

Primary

- Physical functioning

Secondary

- Patient's global assessment of therapeutic effect (overall improvement)
- Perceived pain intensity
- Health Services Utilization
- Negative treatment side effects and/or adverse events

Exclusion Criteria

- Revisions of total joint replacement
- Total hip joint replacement due to fracture
- Studies that did not report scores or values of outcome measures
- Duplicate publications

Search Strategy

The Search Strategy is detailed in Appendix 1.

- Ovid MEDLINE 1966 to March week 2, 2005
- Cumulative Index to Nursing & Allied Health Literature (CINHAL) 1982 to March week 2, 2005
- EMBASE 1996 to week 14, 2005
- Cochrane Database of Systematic Reviews
- Cochrane Central Register of Controlled Trials (CENTRAL)
- The Physiotherapy Evidence Database (PEDro)
- English-language articles only
- Articles published between 1995 and 2005

Study Eligibility

A reviewer who was not blinded to author, institution, and journal of publication evaluated the eligibility of the citations yielded by the literature search. Articles were excluded based on information reported in the title and abstract, and potentially relevant articles were retrieved for assessment. Where the relevance of the article was inconclusive from the abstract or title, the full publication was retrieved for assessment. Characteristics of included and excluded studies are described in Appendices 2 and 3.

Data Extraction

One reviewer extracted data from the included studies. Information on the type of patient, study methods, interventions, co-interventions, outcomes, and adverse events were recorded. The primary author of the study was contacted for missing data where possible.
Assessment of the Quality of the Methods of the Studies

One reviewer evaluated the internal validity of the primary studies using the criteria outlined in the Cochrane Musculoskeletal Injuries Group Quality Assessment Tool (http://cmsig.tees.ac.uk/pdf/New%20Author%20Guide.pdf). (See Appendix 4.) After this, the biases that threatened study validity were summarized. Four methodological biases were considered: selection bias, performance bias, attrition bias, and detection bias. (17)

- Selection bias refers to systematic differences in the intervention groups being compared. Concealment of the randomization assignment schedule is one way to eliminate selection bias
- Performance bias refers to a systematic difference in the care provided to the participants in the comparison groups other than the intervention under investigation. Blinding those providing and receiving the treatment (called double blinding) so that they do not know which group the participants have been allocated to reduces performance bias.
- Attrition bias refers to systematic differences in the loss (e.g., due to dropping out or dying) of participants between the comparison groups in the study.
- Detection bias refers to systematic differences between the comparison groups in outcome assessment. Trials that blind the assessor to the treatment allocation may minimize this bias.

Summarizing the Results and Quality of Evidence

A meta-analysis was conducted when there was adequate data available from 2 or more studies and where there was no statistical and clinical heterogeneity among studies.

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) system (18)(www.gradeworkinggroup.org) (accessed August 8, 2005) was used to summarize the overall quality of evidence supporting the questions explored in the systematic review. This system has 4 levels: very low, low, moderate, and high. The criteria for assigning GRADE evidence are outlined below.

Type of evidence

- RCT: given a high GRADE level to start
- Observational study: given a low GRADE level to start
- Any other evidence: given a very low GRADE level to start

Decrease grade if:

- Serious limitation to study quality (-1, reduce GRADE level by 1 so a high GRADE level will become a moderate grade) or very serious limitation to study quality (-2, reduce GRADE level by 2 so a high GRADE level will become low grade)
- Important inconsistency (-1, reduce GRADE level by 1)
- Some (-1) or major (-2) uncertainty about directness
- Imprecise or sparse data (-1)
- High probability of reporting bias (-1)

Increase GRADE level if:

- Strong evidence of association-significant relative risk of >2 (< 0.5) based on consistent evidence from 2 or more observation studies, with no plausible confounders (+1, increase GRADE level by 1, so a moderate grade will become high. However a high grade will remain high)
- Very strong evidence of association-significant relative risk of > 5 (< 0.2) based on direct evidence with no major threats to validity (+2, increase GRADE level by 2, so a low grade will become a high grade)
- Evidence of a dose response gradient (+1)
- All plausible confounders would have reduced the effect (+1).

GRADE Scoring definitions

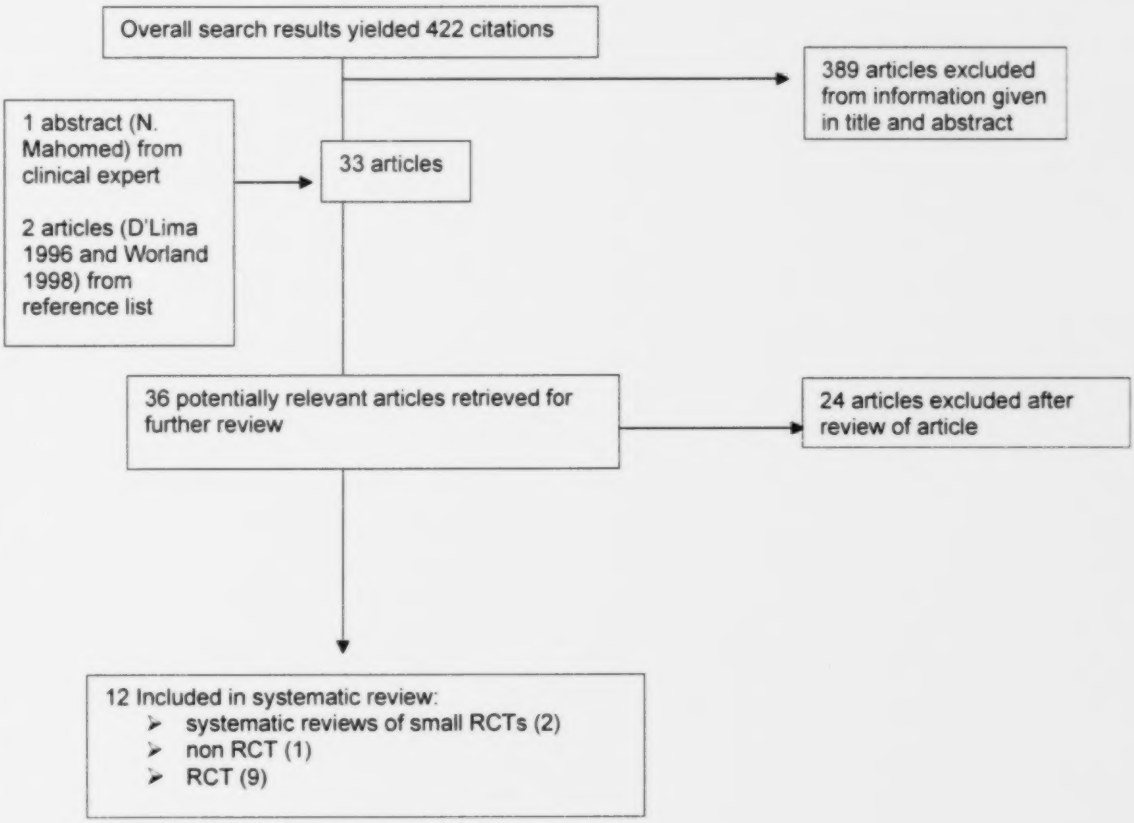
High: ⊕⊕⊕⊕ Further research is very unlikely to change our confidence in the estimate of effect.

Moderate: ⊕⊕⊕◯ Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low: ⊕⊕◯◯ Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low: ⊕◯◯◯ Any estimate of effect is very uncertain.

Results of Literature Review


Overall search results yielded 422 citations
389 articles excluded from information given in title and abstract
1 abstract (N. Mahomed) from clinical expert
2 articles (D'Lima 1996 and Worland 1998) from reference list
33 articles
36 potentially relevant articles retrieved for further review
24 articles excluded after review of article
12 Included in systematic review:
systematic reviews of small RCTs (2)
non RCT (1)
RCT (9)

Summary of Existing Health Technology Assessments

Table 1: Quality of Evidence

Study Design	Level of Evidence	Number of Eligible Studies
Systematic review(s) of large RCTs*	1a	2
Large RCT	1b	4
Large RCT unpublished but reported to an international scientific meeting	1(g)†	1
Small RCT	2	4
Small RCT unpublished but reported to an international scientific meeting	2(g)	0
Non-RCT with contemporaneous controls	3a	1
Non-RCT with historical controls	3b	0
Non-RCT presented at international conference	3(g)	0
Surveillance (database or register)	4a	n/a
Case series (multisite)	4b	n/a
Case series (single site)	4c	n/a
Retrospective review, modeling	4d	n/a
Case series presented at international conference	4(g)	n/a

*RCT refers to randomized controlled trial. A large RCT is defined as one that has adequate power to detect differences in the primary outcome.
†g indicates gray literature.

Medical Advisory Secretariat question 1: What is the effectiveness of inpatient physiotherapy after discharge from the acute care hospital setting compared with physiotherapy delivered in a clinic or home-based setting for patients having primary total hip or knee replacement surgery?

Table 2: Primary studies

Study	Methods	N	Population
Mahomed et al., 2004 (19;20)	RCT-abstract report	234	Knee and hip
Kelly et al., 1999 (21)	Non-RCT	100	Knee and hip

Assessment of Quality of Methods of Included Studies

Th quality of the methods was assessed with the Cochrane Musculoskeletal Injuries Group Methodological Assessment Tool (http://cmsig.tees.ac.uk/pdf/New%20Author%20Guide.pdf) (accessed August 8, 2005). Scores for each of the 12 criteria are reported in Table 3 after which a descriptive report for each criterion is provided. Information reported for the study by Mahomed et al. was obtained from the primary investigator.

Table 3: Assessment of the Quality of the Methods

Study	Criteria*											
	A	B	C	D	E	F	G	H	I	J	K	L
Mahomed, 2004 (19;20) (gray literature)	1	2	0	2	0	No data	No data	2	2	2	2	No data
Kelly, 1999 (21)	0	1	0	2	0	0	2	2	2	2	1	1

*All criteria are scored from 0 to 2. See Appendix 4 for the definition of each score for each criterion.

A. Was the assigned treatment adequately concealed prior to allocation? **B.** Were withdrawals adequately described and included in the analysis (intention-to-treat)? **C.** Were the outcome assessors blinded to treatment status? **D.** Were the treatment and control groups comparable at entry? **E.** Were the participants blind to assignment status after allocation? **F.** Were the treatment providers blind to assignment status? **G.** Were care programs, other than the trial options, identical? **H.** Were the inclusion and exclusion criteria clearly defined? **I.** Were the interventions clearly defined? **J.** Were the outcome measures clearly defined? **K.** Were diagnostic tests used in outcome assessment clinically useful? **L.** Was the surveillance active and of a clinically appropriate duration?

A. Concealment: Information was not available to determine whether allocation concealment was adequately undertaken in the study by Mahomed et al. (19;20)Kelly et al. (21) conducted an observational study in which the study subjects were allowed to self-select their rehabilitation setting (home or inpatient rehabilitation unit) after discharge from the hospital. Therefore, concealment did not occur.
B. Intention-to-treat: Mahomed et al. reported completing an intention-to-treat analysis (personal communication with author, May 2, 2005). Kelly et al. described the reasons for the study withdrawals but did not account for them in the analysis. Four subjects (3 in the home-based group and 1 in the inpatient group), or 4% of the total study population, were excluded from the analysis.
C. Blinding of outcome assessors: Mahomed et al. and Kelly et al. each used a self-reported outcome measure; therefore, assessor blinding was not possible.
D. Baseline comparability: Treatment groups were comparable at baseline in the study by Mahomed et al. However, the treatment groups were not comparable at baseline in the study by Kelly et al. Because of this, Kelly et al. adjusted for confounding variables in the statistical analysis.
E. Study subject blinding: it was not possible to blind the study subjects to the treatment in either study given that the study intervention was the treatment setting. (inpatient rehabilitation vs. home –based physiotherapy rehabilitation)
F. Treatment provider blinding: Information was not available for the study by Mahomed et al. Kelley et al. did not report whether the treatment provider was aware of the patient's participation in the study.
G. Care programs: Information was not available for the study by Mahomed et al. In the study by Kelly et al. implicit in the intervention is that the physiotherapy treatment programs would not be comparable between an inpatient and outpatient setting. Patients in the inpatient setting had more intensive therapy compared with patients who went home. Specifically, patients in the inpatient care facility received physiotherapy more often and received occupational therapy. Additionally, patients discharged from the inpatient rehabilitation facility received 8 extra home visits of physiotherapy compared with those patients discharged directly to home from the acute care setting.
H. Inclusion and exclusion criteria: Both studies clearly defined these.
I. Clearly defined interventions: Both studies clearly defined the study interventions.
J. Clearly defined outcomes: Outcomes were clearly defined in both studies.
K. Clinically useful diagnostic tests: Both studies used clinically useful outcome measurements. However, only Mahomed et al. used the WOMAC, which is considered the clinically optimal outcome measure. Kelly et al. used the self-administered joint rating questionnaire.
L. Duration of follow-up: Mahomed et al. reported data for a 1-year follow-up period. Kelly et al.

reported data for a 3-month follow-up period. A 1-year follow-up was considered optimal.

Given the above assessment of the methods, some biases and limitations were identified (Table 4).

Table 4: Study Biases and Limitations*

Bias	Mahomed et al. 2004	Kelly et al. 1999
Selection	Insufficient data to determine	+++
Performance	Insufficient data to determine	–
Detection	–	–
Attrition	–	–
Other limitations	Grey literature	Did not use WOMAC Short follow-up period (3 months)

*No (–) Possible(+) Probable (++) Yes (+++)

The study by Kelly et al. had more bias than that by Mahomed et al. Much of this is attributed to its observational design. Mahomed et al. have completed the largest study in terms of sample size; however, results have only been presented in abstract format at international and national scientific meetings. Because of this, some information on methods is missing.

Description of Primary Studies

The difference in outcome measures used precluded the synthesis of data among studies. Therefore, a descriptive report of the results of each primary study has been completed. Details of each study can be found in Appendix 2. The study population characteristics are shown in Table 5.

Table 5: Study Population Characteristics

Study	N	Mean Age (SD), Years	% Female	Type of Implant/ Fixation	Diagnosis
Mahomed, 2004 (20)	234	67.7 (10.83)* (total sample)	Not reported in abstract	Not reported	Primarily OA
Kelly, 1999 (21)	100	71.5 (8.7) inpatient physiotherapy 64.0 (11.6) outpatient home-based physiotherapy	78% inpatient 63.3% outpatient home-based physiotherapy	Not reported	Not reported

*From a personal communication with author.

Mahomed et al., 2004

Mahomed et al. (20) completed a multicentre RCT to determine the differences, if any, in functional outcome, pain, and patient satisfaction between people receiving home-based rehabilitation and those receiving inpatient rehabilitation after total knee or hip replacement surgery. Standardized care pathways were followed for both groups. Outcome evaluations including self-reported WOMAC scores for pain, function, and stiffness, as well as patient satisfaction using the SF-36 were done at 6 weeks, 12 weeks,

and 1 year after surgery. This study had 90% power to detect a minimal clinically significant difference in WOMAC scores (Personal communication with primary investigator, May 31, 2005).

The population characteristics are shown in Table 5. Absolute values for outcome measures were not reported in the abstract. Baseline demographics and WOMAC scores were similar among groups. WOMAC scores for pain, physical functioning, and stiffness did not differ between groups at any time. Patient satisfaction scores also did not differ between groups at 6 and 12 weeks or 1 year after surgery.

Conclusions

There were no differences in functional outcomes and patient satisfaction between treatment groups.

Kelly et al., 1999

Kelly et al. (21) did a prospective non-RCT to determine functional outcomes after primary total knee or hip replacement surgery and discharge to either an outpatient home-based rehabilitation program or an inpatient rehabilitation program. A convenience sample of 100 patients was assembled, and results were reported for 96 patients. Patients selected the discharge destination. Patients discharged to home after the acute care hospitalization received home-based physiotherapy, which included 3 1-hour physical therapy sessions per week. They were discharged from home-based therapy pending achievement of criteria that included the ability to walk 100 feet independently with the least-restrictive device; transfer independently from the bed, chair or car; enter and exit the home; and have independence and compliance with a daily exercise program. Patients also received at least one visit from a home care nurse to remove incision staples and supervise care.

Patients admitted to the inpatient rehabilitation setting received 2 1-hour physical therapy sessions and 1 1-hour occupational therapy session each day, 7 days a week. Recreational therapy sessions were also available. Patients were discharged from the inpatient care setting when they could walk independently with the least restrictive device for 60 to 100feet, transfer independently from bed to chair, and carry out a daily exercise program independently. Home physiotherapy was arranged if the physical therapist and physician deemed it was necessary for patients being discharged from the inpatient care setting.

The study outcome measure was a 14-item self-administered joint rating questionnaire completed before surgery, and at 1 and 3 months after surgery. The tool was used to determine the overall impact of the total joint replacement, the patient's perception of pain and use of pain medication, ambulation, and daily functional activities. The total score and the 4 subscores of the questionnaire comprising global assessment, pain, walking, and functioning scores were analyzed. The scale has a test-retest reliability of 0.70. Validity of the instrument was assessed to be 0.69. The joint rating question has been shown to be responsive to the change in clinical condition of the subject. (21)

The mean acute care hospital length of stay was 3.9 days for the home-based physiotherapy group and 4.2 days for the inpatient physiotherapy group ($P > .05$). Sixty-eight (71%) patients with an average age of 64 years (SD, 11.6) chose home-based physiotherapy, and 32 (47%) patients with an average age of 71.5 years (SD, 8.7) chose inpatient physiotherapy. More than 63% of patients discharged to home-based physiotherapy were women, compared with 78% of patients discharged to the inpatient physiotherapy. Of those patients discharged to home-based physiotherapy, 42.6% had received knee replacements, and 57.4% had received hip replacements; whereas 62.5% of patients discharged to the inpatient physiotherapy had received knee replacements, and 37.5% had had hip replacements.

The groups were statistically significantly different in age, living situation (live alone), and comorbid conditions. A discriminant analysis of demographic data determined that living situation ($P < .05$), age (P

< .001), and comorbid conditions ($P < .001$) predicted the choice of inpatient physiotherapy over home-based physiotherapy. Using these variables as covariates in the statistical analysis, both home-based and inpatient physiotherapy groups showed similar improvement (no statistically significant difference) in the mean total score and subscale scores on the self-administered joint rating scale over time (Tables 6 to 10). The author does not report the standard deviation for the mean scores reported in Tables 6 to 10.

Table 6: Total Scores on Self-Administered Joint Rating Questionnaire

Time of Assessment	Inpatient Physiotherapy Group N = 29, Mean	Home-Based Physiotherapy Group N = 67, Mean
Preoperatively	53.5	58.7
1 month postoperatively	70.8	77.5
3 months postoperatively	80.6	87.9

Table 7: Pain Scores on Self-Administered Joint Rating Questionnaire

Time of Assessment	Inpatient Physiotherapy Group N = 29, Mean	Home-Based Physiotherapy Group N = 67, Mean
Preoperatively	10.3	10.7
1 month postoperatively	17.0	18.9
3 months postoperatively	19.9	21.0

Table 8: Walking Scores on Self-Administered Joint Rating Questionnaire

Time of Assessment	Inpatient Physiotherapy Group N = 29, Mean	Home-Based Physiotherapy Group N = 67, Mean
Preoperatively	13.7	15.3
1 month postoperatively	16.3	17.5
3 months postoperatively	18.5	20.7

Table 9: Subjective (Global) Scores on Self-Administered Joint Rating Questionnaire

Time of Assessment	Inpatient Physiotherapy Group N = 29, Mean	Home-Based Physiotherapy Group N = 67, Mean
Preoperatively	9.3	11.7
1 month postoperatively	18.0	20.7
3 months postoperatively	19.6	22.0

Table 10: Activities of Daily Living Scores on Self-Administered Joint Rating Questionnaire

Time of Assessment	Inpatient Physiotherapy N = 29, Mean	Home-Based Physiotherapy, N = 67, Mean
Preoperatively	18.9	19.8
1 month postoperatively	19.5	20.6
3 months postoperatively	22.5	23.5

Ninety percent of people in the inpatient physiotherapy treatment group had home care physiotherapy after discharge from the inpatient facility. The mean number of home care physiotherapy visits was 8.2 for the outpatient home-based physiotherapy group and 7.7 for the inpatient rehabilitation treatment group ($P > .05$). The mean total medical care costs are presented in Table 11.

Table 11: Cost of the Joint Replacement Experience

Measurements	Inpatient Physiotherapy	Home-Based Physiotherapy	*P*
Acute care costs, mean (US)	$15,883 (4.2 days)	$15,467 (3.9 days)	> .05
Post-acute care costs, (inpatient rehab costs), mean (US)	$7,712 (10.1 days)	N/A	N/A
Home physiotherapy costs, mean (US)	$1,067 (7.7 visits)	$1,168 (8.2 visits)	> .05
Total cost, mean (US)	$24,144	$16,918	< .001

Conclusions

Kelly et al. concluded that younger patients that have adequate support systems and no comorbid conditions can recover functional outcomes in a reasonable period at home with physical therapy supervision. Inpatient care may be best reserved for the elderly with comorbid conditions, especially if they live alone. The authors also suggested that discharge planning should consider the patient's age, medical condition, and living situation, as well as the intensity of therapy needed to achieve optimal functioning. Finally, the mean total health care costs were higher for the patients that were discharged to an inpatient rehabilitation setting.

Summary and Overall Quality of Evidence

Two studies testing the effectiveness of an inpatient physiotherapy rehabilitation program compared with an outpatient home-based physiotherapy rehabilitation program on functional outcomes after total knee or hip replacement surgeries were reviewed. The combined number of patients studied was 334. Data could not be synthesized among studies because each they used different measures of physical function.

Mahomed et al. (20) completed a large (Medical Advisory Secretariat Level 1g) RCT with adequate power to detect differences in functional outcomes measured by the WOMAC and patient satisfaction measured by the SF-36 scale after primary total knee or hip replacement surgery in patients treated with either outpatient home-based or inpatient physiotherapy. No differences in functional outcomes at 1 year after surgery between treatment groups were reported. Results of this study have been published only in abstract format. Kelly et al. (21) have completed an observational study using a valid and reliable self-assessment joint rating questionnaire. Results support that patients who are younger than 71 years of age

on average, who do not live alone, and who do not have comorbid illnesses recover adequate function with outpatient home-based physiotherapy. However results were only measured up to 3 months after surgery, and the outcome measure used, the Self-Assessment Joint Rating Questionnaire, is not considered the best one for physical functioning.

GRADE profiles (18) are presented in Tables 12 and 12a. Using the GRADE System, (18) the overall quality of the RCT evidence for the outcome of physical functioning is high. The overall quality of the observational design evidence for the outcome of physical functioning is very low. Therefore, there is high-quality evidence from 1 large RCT to support the use of home-based physiotherapy after primary total hip or knee replacement surgery.

Table 12: GRADE Profile

For question: Should primary total hip or knee replacement patients receive inpatient or outpatient home-based physiotherapy after discharge from the acute care hospital setting?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Com-parison (Study)	Design	Quality	Consistency	Directness	Other modifying factors	In-patient	Home-based	Relative (95%CI)	Quality	Out-come
Physical Functioning (measured with the WOMAC at 1 year)										
(Mahomed et al. (20))	RCT	No serious limitations	Only 1 study	No uncertainty	None	115	119	N/A	⊕⊕⊕⊕	Critical
Quality GRADE	High	High	High	High	High				High	

Table 12a: GRADE Profile

For question: Should primary total hip or knee replacement patients receive inpatient or outpatient home-based physiotherapy after discharge from the acute care hospital setting?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Com-parison (study)	Design	Quality	Consistency	Directness	Other modifying factors	In-patient	Home-based	Relative (95%CI)	Quality	Out-come
Physical Functioning (measured with the Self Assessment Joint Rating Questionnaire at 3 months)										
(Kelly et al. (21))	RCT	None	Only 1 study	Some uncertainty*	none	68	32	N/A	⊕○○○	Critical
Quality GRADE	Low	Low	Low	Very low					Very low	

* Used a suboptimal outcome measure (WOMAC considered optimal), 3 months follow-up considered suboptimal.

Medical Advisory Secretariat question 2: What is the effectiveness of outpatient physiotherapy on functional recovery after TJR compared with a patient self-administered home exercise program only?

Table 13: Primary Studies

Study	Methods	N	Population
Rajan et al., 2004 (22)	RCT*	120	Knee replacement
Kramer, 2003 (23)	RCT	160	Knee replacement
Worland et al., 1998 (24)	RCT	80	Knee replacement

*RCT indicates randomized controlled trial.

Assessment of Quality of Methods of Studies

The quality of methods was assessed using the Cochrane Musculoskeletal Injuries Group methods assessment tool (Appendix 4). Scores for each of the 12 criteria are reported in Table 14, after which a descriptive report for each criterion is provided.

Table 14: Assessment of the Quality of the Methods

	*Criteria											
Study	A	B	C	D	E	F	G	H	I	J	K	L
Rajan, 2004 (22)	1	1	2	2	0	0	2	2	2	1	1	2
Kramer, 2003 (23)	2	2	2	2	0	1	2	2	2	2	2	2
Worland, 1998 (24)	1	2	2	2	0	0	2	1	2	1	1	1

*All criteria are scored from 0 to 2. See Appendix 4 for the definition of each score for each criterion. **A.** Was the assigned treatment adequately concealed prior to allocation? **B.** Were withdrawals adequately described and included in the analysis (intention-to-treat)? **C.** Were the outcome assessors blinded to treatment status? **D.** Were the treatment and control group comparable at entry? **E.** Were the participants blind to assignment status after allocation? **F.** Were the treatment providers blind to assignment status? **G.** Were care programs, other than the trial options, identical? **H.** Were the inclusion and exclusion criteria clearly defined? **I.** Were the interventions clearly defined? **J.** Were the outcome measures clearly defined? **K.** Were diagnostic tests used in outcome assessment clinically useful? **L.** Was the surveillance active and of a clinically appropriate duration?

A. Concealment: Neither Rajan et al. (22) nor Worland et al. (24) report allocation concealment methodology. Therefore, a possible selection bias may exist in these studies. Kramer et al., (23) however, used sealed envelopes to blind the treatment allocation sequence (Personal communication with author, June 13, 2005).
B. Intention-to-treat: Rajan et al. described withdrawals from the study but did not include them in the analysis. However, there was minimal imbalance in the drop-out/withdrawal rate among groups (3 patients in the treatment group and 1 patient in the control group), and overall, 3% of the total study population was lost to follow-up. Kramer et al. stated that they completed an intention-to-treat and a per-protocol analysis. However, case-wise deletion was carried out with no missing data procedures used. Therefore, the full study sample data was not used in the analysis, and greater than 25% of the data were not used in the analysis of the WOMAC outcome (Personal communication with study author, June 13, 2005). Worland et al. did not report any withdrawals after randomization and therefore their analysis is assumed to be an intention-to-treat analysis.
C. Blinding of outcome assessors: All 3 studies used a blinded assessor to measure the study outcome. This controls for a detection bias.
D. Baseline comparability: The treatment and control groups were comparable at entry for all 3 studies. Additionally, Rajan et al. used baseline ROM values as a covariate in the statistical analysis thereby adjusting for the potential confounding effect of varying baseline values between treatment groups.

E. Study subject blinding: Blinding was not possible in any of the 3 studies given the type of intervention (clinic-based physiotherapy vs. patient self administered exercise).
F. Treatment provider blinding: Rajan et al. and Worland et al. did not report if the physiotherapist who treated study patients was aware of the study hypothesis and/or whether the patient was indeed participating in a study. Because of this, a performance bias may have occurred in either study. Kramer et al. (17;23) reported that the physiotherapist treating patients in the clinic-based treatment group did not know the patient was in a study. However, it as unclear if the physiotherapist who was making the home phone calls to the control group knew if the patient was in a study. Because the patients in the control groups in all 3 studies provided their own treatment through self-managed home exercise, the treatment providers were in part the patients themselves; therefore, blinding was in part not possible.
G. Care programs: Care programs among all 3 studies were considered identical.
H. Inclusion and exclusion criteria: Rajan et al. and Kramer et al., but not Worland et al., clearly defined their inclusion and exclusion criteria.
I. Clearly defined interventions: All 3 studies clearly defined the interventions used in the study.
J. Clearly defined outcome measures: Rajan et al. used ROM as the outcome measure, but the method used to capture ROM was not clearly defined. Worland et al. reported that all patients were evaluated using the HSSK system; however, they reported only the flexion ROM and flexion contracture outcome measures, and neither were adequately described or defined. Kramer et al. adequately defined the study outcome measures.
K. Clinically useful diagnostic tests: Kramer et al. used the WOMAC, which is considered clinically useful and optimal. However, Rajan et al. and Worland et al. used ROM, which is considered a suboptimal outcome measure.
L. Duration of follow-up Study: Kramer et al. and Rajan et al. reported 1-year follow-up data; however, Worland et al. reported 6-month follow-up data. A 1-year follow-up is considered optimal.

Based on the analysis of the quality of the methods, biases and limitations were identified (Table 15).

Table 15: Study Biases and Limitations*

Bias	Rajan et al., 2004 (22)	Kramer et al., 2003 (23)	Worland et al., 1998 (24)
Selection	+	+	+
Performance	+	+	+
Detection	–	–	–
Attrition	–	++	–
Other limitations	Results may not be generalizable to hip replacement Clinical usefulness of ROM questionable	Results may not be generalizable to hip replacement	Results may not be generalizable to hip replacement Clinical usefulness of ROM questionable Short follow-up (6 months)

*No (–) Possible (+) Probable (++) Yes (+++)

Summary of Quality of Methods

All 3 studies suffer from similar biases. All studies are limited in their generalizability to patients having primary THR surgery. Moreover, the study by Kramer et al. is vulnerable to attrition bias because of the loss of data due to case-wise deletion of missing values. Only Kramer et al used the WOMAC, considered the optimal outcome measure.

Description of Primary Studies

Clinical heterogeneity and variation in outcome measures used precluded synthesis of data among studies. Therefore, a descriptive report of the results of each study has been completed. Characteristics of each study can be found in Appendix 2. Study population characteristics are reported in Table 16.

Table 16: Study Population Characteristics

Study	N	Mean (SD) Age, Years	Female, %	Type of Implant/Fixation	Diagnosis
Rajan et al., 2004 (22)	120	69.0 (9.3) home exercise + PT*†	61	Not reported	Monoarticular arthrosis
		68 (10) home exercise only	61		
Kramer et al., 2003 (23)	160	68.2 (6.9) home exercise + clinic-based PT	59	Not reported	Osteoarthrosis
		68.6 (7.8) home exercise + monitoring phone call	55		
Worland et al., 1998 (24)	80	69.1 (7.0) home exercise + home-based PT	60	Unconstrained posterior cruciate retraining condylar prosthesis	Not reported
		71.3 (10) home exercise + CPM*	71		

*PT indicates physiotherapy; CPM, continuous passive motion.
†Author does not state whether PT was administered as home-based or clinic-based treament

Rajan et al., 2004

Rajan et al. (22) did an RCT to determine if there was any benefit to receiving outpatient physiotherapy by a physiotherapist in addition to a self-administered home exercise program, compared with doing only a self administered home exercise program, after primary TKR surgery. The authors did not say if the outpatient physiotherapy was clinic-based or home-based. The study population characteristics are shown in Table 16.

Patients were randomized to receive either outpatient physiotherapy with a physiotherapist 4 to 6 times, in addition to practising a home exercise protocol on their own after discharge from the hospital, or to practising a home exercise program on their own (home-alone group). Patients in both groups were given a home exercise protocol to follow after they were discharged. Rajan et al. measured ROM at baseline (discharge from hospital), and at 3, 6, and 12 months postoperatively and reported results for 116 of 120 study participants. A blinded assessor was used to measure outcomes. The baseline ROM was included as a covariate in the statistical analysis. This study was designed with 95% statistical power to detect a clinically significant difference at $P < .05$ of 10 degrees in flexion ROM with an estimated standard deviation of 12 degrees (effect size of 0.8).

The authors did not report length of hospital stay in the acute care setting. The greatest difference in ROM of the knee between groups was at 6 months postoperatively (home exercise + physiotherapy mean, 97 [SD, 9.0] degrees; home exercise only mean, 93 [SD, 7.9] degrees). This did not achieve statistical significance ($P < .07$).

Conclusions

Rajan et al. concluded that there was no clinically important difference at 1 year in the degrees of flexion ROM of the knee in patients who received outpatient physiotherapy in addition to practising a home exercise program compared with patients practising a home exercise protocol only after TKR surgery.

Kramer et al., 2003

Kramer et al. (23) did an RCT to determine if there was any benefit to receiving outpatient clinic-based physiotherapy in addition to practicing a self administered home exercise program. The study's population characteristics are shown in Table 16. Kramer et al. randomized patients to receive either outpatient clinic-based physiotherapy in addition to a home exercise program or to receive monitoring phone calls by a physiotherapist in addition to a home exercise program. In the study, the type of prosthesis, was randomly assigned to the patients as well.

Patients in the outpatient clinic-based physiotherapy group received 1 hour of physiotherapy twice a week beginning the second week postoperatively and continuing up to and including the 12th week.. Those in the phone call group received a 5 to 15 minute phone call from a physiotherapist at least once between the second week postoperatively and the sixth week postoperatively and then once between weeks 7 and 12. During the phone call, the physiotherapist asked if the patient was experiencing any problems with practising the exercises, reminded the patient of how important it is to do the exercises, and provided advice on wound care, scar treatment, and pain control. Patients in this group were also given a phone number that they could use to contact the physiotherapist if questions arose.

Patient compliance with the home exercise program was monitored with an exercise log-book. Compliance was defined as completion of the home exercises at least 90% of the time.

While in the hospital all patients received standard physiotherapy twice daily for 20 minutes. After discharge from the hospital, all patients were given 2 booklets of common home exercises. Patients in both groups were asked to practise these exercises 3 times per day for 12 weeks. Patients in the outpatient clinic-based treatment group completed the common exercises twice daily on the clinic days and 3 times daily on the non-clinic days.

Kramer et al. measured nine outcome variables including total scores on the Knee Society Clinical Rating Scale (KSCRS), the WOMAC, and on the SF-36, as well as scores on the pain scale component of the KSCRS, the WOMAC, and scores on the functional subscale of the WOMAC. Additionally, distance walked during the 6-minute walk test, the number of stairs climbed and descended in the 30-second stair test, and active knee flexion ROM were quantified. All nine outcomes were measured before surgery and at 12 and 52 weeks postoperatively. Sample size was predicated on a effect size of 0.5 for the KSCRS with an 80% power (Personal communication with study author, June 13, 2005). The level of statistical significance was adjusted to .01 to minimize the occurrence of an alpha (type 1) error due to multiple comparisons of nine outcome variables.

Patients who had full datasets for the 3 follow-up periods (before surgery, and 12 and 52 weeks after surgery) were included in the intent-to-treat and per-protocol analysis.

There were 22 patients lost to their assigned group in the home exercise plus monitoring phone call group and 15 in the home exercise plus outpatient clinic-based treatment group. The mean length of hospital stay for the home exercise plus outpatient clinic-based therapy group was 5.2 days (SD, 1.7), and for the home exercise plus monitoring phone call group it was 5.1 days (SD, 1.5; statistical significance not reported by author). Outcome data were reported graphically by the authors for total KSCRS, WOMAC, and SF-36 scores, and for the 6-minute walk test, the 30-second stair climb, and knee flexion ROM.

Therefore, absolute group mean data values are not available.

The mean number of physiotherapist phone calls to the home exercise only group was 5 (SD, 4) during the first 11 weeks. Regardless of treatment group, the scores on all 9-outcome variables before surgery, and at 12 and 52 weeks after surgery, were statistically significantly different ($P < .01$), with the exception of the pain scores measured using the KSCRS at 12 and 52 weeks postoperatively. Surgeon- or prostheses-related effects did not reach statistical significance for any of the 9-outcome variables.

During the monitoring phone calls, the physiotherapist identified 6 patients in the home-exercise plus monitoring phone call group who had potentially major medical complications including unresolved swelling, infection, and deep vein thrombosis. Twelve patients in the home exercise plus phone calls group, and 6 patients in the home exercise plus clinic-based physiotherapy group, were lost to follow-up because of medical issues related to the surgically treated knee (2 in the clinic-based group, 6 in the phone call group) and other medical issues (4 in the clinic-based group and 6 in the phone call group). (See Tables 17 and 18.)

Table 17: Patients With Complications

Complication	Home Exercise + Clinic-Based PT*	Home Exercise + Monitoring Phone Calls
Medical issues related to knee with replaced joint	2	6
Other medical issues	4	6

*PT indicates physiotherapy.

Table 18: Fisher's Exact Test of Patients With Complications*

Complication	Home exercise + physiotherapy	Home exercise only
Yes	6	12
No	74	68
Number of patients	80	80

*Fisher's exact test = not significant. (Statistical analysis done by Medical Advisory Secretariat.)

Conclusions

Kramer et al. concluded that patients who practise a home exercise program on their own and who receive monitoring phone calls from a physiotherapist have similar physical functioning at 1 year after surgery to those who practise a home exercise program on their own and receive clinic-based physiotherapy.

Worland et al., 1998

Worland et al. (24) did an RCT to determine if there was any benefit to receiving home-based physiotherapy in addition to doing a self-administered home exercise program, compared with using continuous passive motion (CPM) therapy at home and practising a self-administered home exercise program, after primary TKR surgery. A CPM device is a motorized apparatus that passively moves a joint through a specific ROM.(25) The study's population characteristics are shown in Table 16. Patients were randomized to receive either home-based physiotherapy 1 hour 3 times per week for 2 weeks or self-administered CPM therapy for 3 hours daily for 10 days.

Both groups were instructed to continue practising exercises on their own at home. Worland et al. reported measuring knee flexion ROM, flexion contracture, and the HSSK score before surgery and at 2

weeks, 3 months, and 6 months after surgery. This study was designed with an 80% power to detect a difference of at least 4.2 degrees in knee flexion and at least 0.7 degrees in flexion contraction.

The mean length of hospital stay was 3.5 days (across all patients). No standard deviation was reported. The HSSK score and knee flexion ROM did not differ between treatment groups preoperatively or at 2 weeks, 6 weeks, or 6 months postoperatively. There was a statistically significant difference in flexion contracture in the control group (CPM plus home exercises) compared with the treatment group (home-based physiotherapy plus home exercises) at 2 weeks postoperatively (CPM plus home exercises, 4.2 [SD, 5.4 degrees] vs. home-based physiotherapy plus home exercises, 2.1 [SD, 3.3 degrees; $P < .047$]). This did not differ preoperatively, or at 6 weeks or 6 months postoperatively. Of note, Worland et al. did 7 statistical tests with no adjustment in the level of significance for multiple testing. Compliance with the home exercise program was high, with 2 patients in the CPM plus home-based exercise group and 1 patient in the home-based physiotherapy plus home exercise group considered to be noncompliant.

Conclusions

Worland et al. concluded that CPM in addition to practising a home exercise program is an adequate rehabilitation alternative associated with lower costs and no difference in physical functioning outcomes compared with receiving home-based physiotherapy and practising a home exercise program.

Summary and Overall Quality of Evidence

Three studies testing the effect of outpatient home-based or clinic based physiotherapy in addition to a self-administered home exercise program, compared with a self-administered exercise program only or in addition to using another therapy (phone calls or CPM), on postoperative physical functioning after primary TKR surgery were reviewed. The combined number of patients in these studies is 360. Rajan et al. (22) and Worland et al. (24) reported no difference in change from baseline in flexion ROM between those patients receiving outpatient or home-based physiotherapy and doing a home exercise program compared with patients who practised a home exercise program only with or without CPM. Kramer et al. (23) reported no difference in WOMAC scores between patients receiving clinic-based physiotherapy and practicing a home exercise program and those who received monitoring phone calls and did a home exercise program after TKR surgery.

Negative results might be attributable to a type II statistical error that is often due to failure to complete a sample size calculation a priori. However, all 3 studies did this sample size calculation a priori. Rajan et al. and Worland et al. used the difference in degrees of flexion ROM between study groups, and Kramer et al. used the difference in KSCRS. Rajan et al. estimated a 10-degree difference in flexion ROM between groups. However, the greatest difference measured after adjusting for baseline flexion ROM values was 2.8 (95% CI, -0.19–5.8) at 6 months. Likewise, Worland et al. found a mean difference between groups of 4.2 degrees in flexion ROM, but the largest difference measured at 2 weeks after surgery was 2.1 (95% CI, -3.02–7.22). Both studies had few dropouts. Therefore, the negative results of both studies are likely valid. Kramer et al. estimated an effect size of 0.5 between study groups on the KSCRS. However, no more than 76% of the data were used in the statistical analysis. Therefore, a type II error is possible.
A GRADE quality of evidence profile is shown in Tables 19 and 19a. The overall quality of the RCT evidence for the outcome of physical functioning measured by the WOMAC is low to moderate; however, these results are not generalizable to patients undergoing THR surgery. The overall quality of the RCTs for the outcome physical functioning measured by ROM is low. WOMAC, not ROM, is the optimal outcome measure.

Therefore, there is low-to-moderate quality evidence from 1 large RCT that there is no advantage to

receiving clinic-based physiotherapy in addition to practising a home exercise routine, compared with receiving monitoring phone calls from a physiotherapist and practising a home exercise program, on physical functioning at 1 year after TKR surgery.

Table 19: GRADE Profile

For the question: Should primary total knee replacement patients receive outpatient physiotherapy (clinic or home-based) in addition to practising home exercises after hospital discharge?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Comparison (study)	Design	Quality	Consistency	Directness	Other modifying factors	PT + home exercise	Home exercise only	Relative (95%CI)	Quality	Outcome
Physical Functioning (measured as range of motion)										
(Rajan et al. (22) and Worland et al. (24))	RCT	Possible selection bias as concealment not reported but study not downgraded	Consistent results	Major uncertainty*	None	109	97	Not done due to clinical heterogeneity	⊕⊕○○	Critical
Quality GRADE	High	High	High	Low (-2)					Low	

*Uncertainty raised around directness of ROM as an outcome measure. Therefore, GRADE level decreased 2 levels.

Table 19a: GRADE Profile

For the question: Should primary total knee replacement patients receive outpatient (clinic -based) physiotherapy in addition to practising home exercises after discharge from an acute care hospital setting?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Comparison (study)	Design	Quality	Consistency	Directness	Other modifying factors	PT+ home exercise	Phone call +Home exercise	Relative (95%CI)	Quality	Outcome
Physical Functioning (measured by WOMAC)										
(Kramer et al. (23))	RCT	Serious limitations (-1)/very serious (-2)*	1 study	None	None	80	80		⊕⊕○○ ⊕⊕⊕○	Critical
Quality GRADE	High	Low to moderate	Low to moderate	Low to moderate	Low to moderate				Low to moderate	

*Probable attrition bias rated serious to very serious limitation.

Medical Advisory Secretariat question 3: What is the effect of a preoperative exercise program on functional recovery after primary TKR or THR?

Table 20: Systematic Reviews and Primary Studies

Study	Methods	Population
Ackerman et al., 2004 (26)	Systematic review	Knee and hip
Lucas, 2004 (11)	Systematic review	Knee
Beaupre et al., 2004 (27)	RCT*	Knee

D'Lima, 1996 (13)	RCT	Knee
Rodgers et al., 1998 (13;28)	RCT	Knee
Gilbey et al., 2003 (13;29)	RCT	Hip
Gocen et al., 2004 (13;30)	RCT	Hip

*RCT indicates randomized controlled trial.

Ackerman et al. 2004

The purpose of the systematic review by Ackerman et al. 2004 (26) was to review the literature on preoperative physiotherapy for patients waiting for lower limb joint replacement surgery.

- Inclusion criteria: RCT; full paper, English-language, study evaluates postoperative outcomes.
- Exclusion criteria: any study not reported in a full paper.
- Methods criteria: the quality of the included studies was assessed using the PEDro Scale.
- Search Strategy: MEDLINE, CINAHL, ISI Web of Science, PEDro. All databases were searched up to 2003.

The results are shown in Table 21.

Table 21: Studies in Systematic Review by Ackerman et al. (26)

Study	Population	Study Included in the MAS* Systematic Review?
Weidenheilm, 1993	Unicompartmental knee replacement	No
D'Lima, 1996	Total knee replacement	Yes
Rodgers, 1998	Total knee replacement	Yes
Wang, 2002	Total hip replacement	Yes
Gilbey, 2003	Total hip replacement	Yes

*MAS indicates Medical Advisory Secretariat.

Conclusions

Ackerman et al. concluded that preoperative physiotherapy is not effective in improving functional recovery and pain after TKR surgery and any effects after THR surgery cannot be adequately determined.

Four of the 5 studies included in the systematic review by Ackerman et al. are reviewed and described in the Medical Advisory Secretariat's systematic review. The study by Weidenheilm et al. (26) did not meet the inclusion criteria for the review.

Lucas 2004

The purpose of the review by Lucas 2004 (11) was to determine the effectiveness of a preoperative physical therapy program for adults with OA undergoing a primary TKR.

Inclusion Criteria: adults 55 year of age or older with OA; undergoing primary TKR including unicondylar knee replacement; studies using a validated measurement scale.

- Exclusion criterion: rheumatoid arthritis.
- Methods criteria: the quality of the studies was assessed, but no formal assessment tool was used.
- Search strategy: Cochrane database, PEDro, MEDLINE, CINAHL, EMBASE, were searched. Author

stated no search date criteria. The results are shown in Table 22.

Table 22: Studies in the Systematic Review by Lucas (11)

Study	Population	Study Included in the MAS* systematic review?
Weidenheilm et al., 1993	Unicompartmental knee replacement	No
D'Lima et al., 1996	Total knee replacement	Yes

*MAS indicates Medical Advisory Secretariat.

Conclusions

Lucas concluded that there is not enough evidence to determine the benefit of preoperative physiotherapy on functional recovery after TKR. Of the studies Lucas reviewed, only that by D'Lima et al. (13) is included in the Medical Advisory Secretariat's systematic review that follows.

Since the publication of the systematic reviews by Ackerman et al. (26) and Lucas (11), 2 more RCTs, 1 each for total knee and hip replacement surgery, have been added to the literature and are examined in the Medical Advisory Secretariat's systematic review that follows. The literature on preoperative exercise is examined separately for TKR and THR surgery.

Summary of Medical Advisory Secretariat Review

Medical Advisory Secretariat question 3A: What is the effect of a preoperative exercise program on functional recovery after primary TKR surgery?

Table 23: Primary Studies

Study	Type of Study	N
Beaupre et al., 2004 (27)	RCT*	131
Rodgers et al., 1998 (28)	RCT	23
D'Lima et al., 1996 (13)	RCT	30

*RCT indicates randomized controlled trial.

To ascertain the quality of the methods, each study was assessed using the Cochrane Musculoskeletal Injuries Group Methodological Assessment tool (Appendix 4). Scores for each of the 12 criteria are reported in Table 24, after which a descriptive report for each criterion is provided.

Table 24: Primary Studies

Studies	Criteria*											
	A	B	C	D	E	F	G	H	I	J	K	L
Beaupre et al., 2004 (27)	2	1	2	2	0	0	2	1	2	2	2	2
Rodgers et al., 1998 (28)	0	1	0	2	0	0	0	2	2	2	1	1
D'Lima et al., 1996 (13)	1	2	0	2	0	0	2	2	2	2	1	1

*All criteria are scored from 0 to 2. See Appendix 4 for the definition of each score for each criterion. **A.** Was the assigned treatment adequately concealed prior to allocation? **B.** Were withdrawals adequately described and included in the analysis (intention-to-treat)? **C.** Were the outcome assessors blinded to treatment status? **D.** Were the treatment and control group comparable at entry? **E.** Were the participants blind to assignment status after allocation? **F.** Were the treatment providers blind to

assignment status? **G.** Were care programs, other than the trial options, identical? **H.** Were the inclusion and exclusion criteria clearly defined? **I.** Were the interventions clearly defined? **J.** Were the outcome measures clearly defined? **K.** Were diagnostic tests used in outcome assessment clinically useful? **L.** Was the surveillance active and of a clinically appropriate duration?

A. Concealment: Beaupre et al. (27) reported adequate concealment of the treatment allocation by using consecutively numbered opaque envelopes. However, Rodgers et al. (28) assigned treatment based on geographic location; patients living outside the local hospital area were assigned to the control (no preoperative exercise) group. D'Lima et al. (13) did not report treatment allocation methodology.
B. Intention-to-treat: Beaupre et al. and Rodgers et al. described study subject withdrawals, but did not do an intention-to-treat analysis. Beaupre et al. reported that 14 subjects from the preoperative exercise group (treatment) and 8 from the no preoperative exercise group (control) withdrew. Rodgers et al. reported that 2 patients in the preoperative exercise group (treatment) withdrew, as did 1 patient in the no preoperative exercise group (control); however, withdrawals were not included in the analysis. D'Lima reported no dropouts; therefore an intention-to-treat analysis was completed.
C. Blinding of outcome assessors: Beaupre et al. reported using an outcome assessor who was blinded to the treatment allocation. However, neither Rodgers et al. nor D'Lima et al. reported assessor blinding.
D. Baseline comparability of treatment groups: There was good comparability across groups.
E. Study subject blinding: Blinding of the study subjects to the treatment allocation was not feasible in any of the 3 studies given the type of intervention (preoperative exercise).
F. Treatment provider blinding: None of the studies reported if the treatment providers were blinded to the patient's treatment allocation.
G. Care programs: Beaupre et al. and D'Lima et al. described identical care programs for the treatment and control groups other than the study intervention. However, in the study by Rodgers et al., 2 methodological issues may have lead to important differences in the care program between treatment groups. First, the senior author of the study determined which study subjects would receive physiotherapy after discharge from the hospital. It is unknown if the senior author was blinded to the study treatment allocation. If not, this raises an issue of potential bias in treatment care programs between groups. Second, depending on the patient's progress and living conditions, they were either discharged home with instructions to practise a home physical therapy program or transferred to a rehabilitation hospital for supervised physical and occupational therapy. It is likely there were differences between the home and inpatient rehabilitation programs.
H. Inclusion and exclusion criteria: Rodgers et al. and D'Lima et al. adequately reported inclusion and exclusion criteria. Beaupre et al. did not explicitly report any exclusion criteria.
I. Clearly defined interventions: All studies clearly defined the study treatment interventions.
J. Clearly defined outcome measures: All 3 studies clearly defined the outcome measures used.
K. Were diagnostic test used clinically useful: Beaupre et al. used the WOMAC, whereas Rodgers et al. and D'Lima et al. used the HSSK scale (Table 27). Of these, the WOMAC is considered the clinically optimal outcome measure.
L. Duration of follow-up: Beaupre et al. reported 1-year follow-up data. However, Rodgers et al. and D'Lima et al. reported results for 6- and 3-month follow-up periods respectively. A 1-year follow-up is considered optimal.

Given the above methods assessment, biases and limitations were identified (Table 25).

Table 25: Study Biases and Limitations*

Beaupre et al., 2004 (27)	Rodgers et al., 1998 (28)	D'Lima et al., 1996 (13)
–	+++	++

+	++	++
–	+	++
+	–	–

*No (–) Possible (+) Probable (++) Yes (+++)

The RCT completed by Beaupre et al. had the fewest biases or limitations compared with that completed by either Rodgers et al. or D'Lima et al.

It was not possible to synthesize the results from the primary studies listed in Table 24 because of the different parameters reported for similar outcome measures. For example, both D'Lima et al. and Rodgers et al. used the HSSK scale to measure functional recovery after surgery. D'Lima et al. reported the mean and range scores; however, it is unclear if Rodgers et al. reported mean or median scores.

In another example, Beaupre et al. and D'Lima et al. reported the means and standard deviations for WOMAC scores and HSSK scores, respectively. However, Beaupre et al. reported only the scores for the physical functioning subscale of the WOMAC, while D'Lima et al. reported the total score for the HSSK. Because the HSSK total score includes other criteria besides physical functioning, such as pain and ROM, the data were not suitable for meta-analysis. Regarding ROM, both Beaupre et al. and D'Lima et al. reported knee flexion ROM. However, Beaupre et al. reported the means and standard deviations, whereas D'Lima et al. report the means and ranges. Therefore, these data cannot be synthesized. Because of this, a descriptive report of the results of each study has been completed.

Characteristics of each study can be found in Appendix 2. Study population characteristics, treatment interventions, and outcome measures are shown in tables 25, 26, and 27, respectively.

Table 25: Study Populations*

Study	N	Mean (SD) Age, Years	Female, %	Mean Body Mass Index	Type of Implant/ Implant Fixation	Diagnosis
Beaupre et al., 2004 (27)	131	67 (7) treatment 67 (6) control	60% treatment 50% control	32 (SD, 6) treatment 31 (SD, 5) control	Posterior cruciate retaining prosthesis/‡ Cemented§	Non-inflammatory arthritis.
Rodgers et al., 1998 (28)	23	70, range, 63–98 treatment 65, range, 50–83 control	60% treatment 50% control	Not reported	Posterior stabilized total knee implant/cemented	Osteoarthritis
D'Lima et al., 1996 (13)	30	71.6 (6.6) CV† 68.5 (4.6) PT† 69.5 (6.5) control	20% CV† 70% PT† 50% control	Not reported	Press fit Condylar total knee system/ type of fixation not reported	Osteoarthritis Rheumatoid arthritis

*Treatment = preoperative exercise; control= no preoperative exercise.
†CV indicates cardiovascular training; PT, physiotherapy.
‡86% in treatment group and 85% in control group.
§58% cemented in treatment group, and 53% cemented in control group.

Table 26: Study Treatments

Study	Treatment	Control	Co-interventions
Beaupre et al., 2004 (27)	A standardized educational program + an exercise program. The exercise program was designed to improve knee mobility and strength using simple exercises similar to those practiced in the postoperative period. Frequency of treatment: 3 times per week for 4 weeks.	Regular activities before surgery. None of the control subjects attended a formal exercise program before surgery but some subjects reported performing home exercises using exercises learned in previous physiotherapy sessions.	Both groups received the standard postoperative mobilization routine used at the hospital after surgery.
Rodgers et al., 1998 (28)	A preoperative exercise program tailored to the subject's baseline capacity. Subjects were re-evaluated and advanced in the program after 3 weeks. Exercises included: Stretching and warm ups, heel slides, isometric quadriceps sets, straight leg raises, short arc quadriceps sets, standing squats, step-ups, bicycling. Frequency of treatment: 3 times per week for 6 weeks. The duration of each treatment was not reported.	Control subjects followed the usual preoperative care (no preoperative exercise).	Both groups received preoperative physical therapy instruction in the usual postoperative exercises protocol. All patients received the same post postoperative exercises including: Ankle pumps, quadriceps sets, straight leg raises, short arc quads, heel slides, assisted flexion, calf stretching, hamstring stretching, hip abduction, hip adduction. Gait training with weight bearing as tolerated beginning on the first postoperative day was also done.
D'Lima et al., 1996 (13)	A private physiotherapy-training program was administered to strengthen the upper and lower	There were 2 control groups. Group 1 met with a	None

Study	Treatment	Control	Co-interventions
	limbs and improve the knee ROM. The program included calf, hamstrings, and quadriceps muscle stretching. Isometric and isotonic strengthening exercises for the triceps sural, quadricep and hamstrings, hip flexors, hip extensors, hip abductors, shoulder flexors, shoulder abductors, and triceps brachii. Weight lifting was used as tolerated. Frequency of treatment program: 45 minutes, 3 times per week for 6 weeks.	physiotherapist preoperatively for 45 minutes and was given printed material describing the postoperative exercise regimen. Group 2 participated in 45-minute cardiovascular conditioning training sessions, 3 times per week for 6 weeks. 12 of these sessions included arm and cycle ergometry, light stretching, muscle toning, and aerobic activity. 6 sessions included aquatic exercises.	

Table 27: Study Outcome Measures

Study	Physical Functioning	Pain	Global Assessment	Quality of Life	Length of Follow-up
Beaupre et al., 2004 (27)	WOMAC, knee ROM, quadriceps strength, hamstring strength, and Health Services Utilization	WOMAC	Not assessed	SF-36	Baseline, preoperatively, then postoperatively at 3 months, 6 months and 1 year†
Rodgers et al. 1998 (28)	HSSK,* knee ROM, Isokinetic flexion and extension, and walking speed (normal and tandem gait)	Not assessed	Not assessed	Not assessed	Baseline, preoperatively, then postoperatively at 6 weeks and 3 months‡
D'Lima et al., 1996 (13)	HSSK, Arthritis Impact Measurement Scale and the Quality of Well-Being Instrument	Not assessed	Not assessed	Quality of Well being and Arthritis Impact Measurement Scale	6 weeks preoperatively, 1 week preoperatively, then postoperatively at 3 weeks, 12 weeks, 24 weeks and 48 weeks

*Assessed at baseline and 3 months only
† Both treatment and control groups were assessed 6 weeks before surgery.
‡ Baseline score completed in treatment group at 6 weeks before surgery.

Beaupre et al. 2004

Beaupre et al. (27) did an RCT to determine the effectiveness of a preoperative exercise and education program on functional outcomes, health-related quality of life, health service utilization, and health system costs after TKR surgery. Table 25 describes the study population characteristics, Table 26 the study treatment interventions, and Table 27 the outcome measures and assessment periods used by Beaupre et al. (27) Patients scheduled for primary TKR surgery were randomized to participate in either a preoperative education and exercise program (treatment) or receive the usual preoperative care (control), which did not include a formal exercise program or educational program. Study sample size was predicated on detecting a 10-point difference in WOMAC scores between groups with a power of 0.80 and a 2-tailed alpha test of .05.

Fifty-one patients were evaluated in the treatment group, and 58 patients were in the control group. Results for pain, stiffness, and physical functioning measured using the WOMAC subscales are shown in Tables 28 to 30. Baseline scores for pain, stiffness, and physical functioning were not statistically different between groups. There was no statistically significant difference in the baseline scores for pain, stiffness, and physical functioning and scores immediately before surgery in the 51 patients participating in the preoperative exercise program. While pain, stiffness, and physical functioning scores improved significantly in both groups over time ($P = .00$) (Tables 28 to 30), neither group improved significantly more than the other (interaction effect for pain, $P = .4$; interaction effect for stiffness, $P = .55$; interaction effect for physical functioning, $P = .83$).

Table 28: WOMAC Pain Subscale Scores*

Time	Treatment (Preoperative Exercise) Mean (SD)	Control (No Preoperative Exercise) Mean (SD)
Baseline	50 (16)	50 (19)
Immediately preoperatively	48 (13)	49 (17)
3 months postoperatively	74 (18)	73 (14)
6 months postoperatively	80 (15)	75 (15)
1 year postoperatively	82 (13)	80 (16)

*Scored from 0 to 100. A score of 100 indicates no pain.

Table 29: WOMAC Stiffness Subscale Scores*

Time	Treatment (Preoperative Exercise) Mean (SD)	Control (No Preoperative Exercise) Mean (SD)
Baseline	46 (16)	44 (22)
Immediately preoperatively	45 (19)	44 (18)
3 months postoperatively	62 (17)	61 (18)
6 months postoperatively	82 (13)	80 (16)
1 year postoperatively	67 (18)	71 (21)

* Scored from 0 to 100. A score of 100 indicates no stiffness.

Table 30: WOMAC Physical Functioning Subscale Scores*

Time	Treatment (Preoperative Exercise) Mean (SD)	Control (No Preoperative Exercise) Mean (SD)
Baseline	51 (18)	50 (17)
Immediately preoperatively	50 (14)	51 (17)
3 months postoperatively	75 (15)	75 (15)
6 months postoperatively	78 (15)	74 (15)
1 year postoperatively	77 (14)	77 (16)

* Scored from 0 to 100. A score of 100 indicates no dysfunction.

There were no significant differences between groups on any of the 8 dimensions of the SF-36 general health questionnaire.

There were no significant differences in either group in ROM of the knee, quadriceps strength or hamstring strength scores (interaction effect ROM, $P = .13$; interaction effect quadriceps strength, $P = .24$; interaction effect hamstring strength, $P = .78$)

Regarding hospital health service utilization, there were no significant differences between groups in the average acute care hospital length of stay, length of stay in an inpatient rehabilitation hospital, readmission length of stay, or health care costs after discharge from the acute care hospital setting. When total length of stay (acute care plus inpatient rehabilitation care) was analyzed, subjects in the treatment group stayed an average of 1.5 days less in the health care system than did subjects in the control group. However, the author acknowledges that this did not reach statistical significance because the study was underpowered to detect this difference. Although more patients in the control group (31 people) were sent to an inpatient rehabilitation facility compared with the treatment group (23 people), this was also not statistically different (P = .66). The length of stay in the inpatient rehabilitation setting was the same regardless to which treatment group the patient was assigned. Complications did not differ significantly between treatment groups (Table 31).

Table 31: Complications Between Groups

Complication	Treatment Group	Control Group
Pulmonary embolism	2	2
Deep vein thrombosis	3	6
Superficial infection	2	3
Hospital readmission for manipulation for poor ROM	2	1
Deep infection requiring reoperation to remove the artificial joint and reinsert a new one (exchange arthroplasty)	1	0

Conclusions

Beaupre et al. concluded that there were no significant changes in functional recovery or health-related quality of life during the first year after primary TKR surgery in patients that were treated with an exercise program 4 weeks before surgery compared with patients that were not. However, possible differences between groups that may have occurred earlier than 3 months after surgery were missed because the initial postoperative outcome assessment was taken no earlier than 3 months after surgery.

Rodgers et al., 1998

Rodgers et al. (28) did an RCT to determine the efficacy of preoperative physical therapy for patients scheduled for TKR surgery. Table 25 describes the study population characteristics, Table 26 the interventions, and Table 27 the outcome measures and assessment periods. Based on their geographic location, patients were assigned either to a treatment group, which participated in a preoperative exercise program, or to a control group that did not participate in a preoperative exercise program. Patients that lived closer to the hospital were enrolled in the treatment group.

Results showed the scores on the HSSK rating scale did not differ significantly in the preoperative exercise (treatment) group (n = 10) compared with the control group (n = 10) at 3 months (Table 32). Extension and flexion ROM, thigh circumference, the 10-meter walking test for both normal and tandem gait, and the cross-sectional muscle area of the thigh did not change significantly in either treatment or control groups from baseline to 3 months after surgery. There were no significantly different changes in isokinetic flexion or extension from baseline to 3 months after surgery in either treatment group. While the author reports improvements in isokinetic peak torque data at specific periods for both groups, these

results were obtained by completing 18 multiple paired t-tests without adjustment in the level of statistical significance. Therefore, these results are likely due to a type 1 statistical error (chance).

The length of stay in the acute care hospital setting averaged 6 days (range, 3–12 days) for the treatment group and 5 days (range, 3–9 days) for the control group. Six patients in the treatment group and 4 patients in the control group needed to be discharged to an inpatient rehabilitation service. When the total length of stay, including days in the acute care setting and days in the inpatient rehabilitation care setting, were combined, the total length of stay did not differ significantly between groups. The treatment group had a total mean length of stay of 8 days; the control group, 7 days (standard deviations not reported). Complications did not differ between groups. No patients in either group developed deep vein thrombosis or required knee manipulation for poor ROM.

Table 32: Hospital for Special Surgery knee Scale Scores*

Time	Treatment Group	Control Group
Baseline	60 (range, 44–79)	Not done
Immediately preoperatively	Not done	54 (range, 40–67)
3 months postoperatively	87 (range 79–95)	85 (range, 68–97)

*The author did not indicate if the data are means or medians.

Conclusions

The authors concluded that preoperative physical therapy 6 weeks before surgery does not have a significant effect on physical functioning at 3 months after TKR surgery.

D'Lima et al., 1996

D'Lima et al. (13) did an RCT to determine the effects of preoperative exercise, general cardiovascular conditioning, or no preoperative exercise on patients having primary TKR surgery. Table 25 describes the study population characteristics, Table 26 the study treatment interventions, and Table 27 the outcome measures. Patients were randomized to participate in 1 of 3 groups beginning 6 weeks before surgery: preoperative exercise (treatment group, n = 10), cardiovascular training (control group 1, n = 10), or no preoperative exercise (control group 2, n = 10).

The scores on the HSSK rating scale, the Arthritis Impact Measurement Scale and the Quality of Well Being did not differ significantly in the preoperative exercise group (treatment) compared with either control groups. Patients receiving preoperative exercise showed a minor but non-statistically significant decrease in HSSK pain scores from pretreatment to immediately before surgery. Patients receiving either preoperative exercise or no preoperative exercise had a decrease in their total physical function before surgery as measured by the HSSK physical function subscale, but this was not statistically significant.

Conclusions

D'Lima et al. concluded that the study results failed to support an effect of preoperative exercise beginning 6 weeks before surgery on physical functioning after surgery.

Summary and Overall Quality of Evidence

Three studies testing the effect of preoperative exercise on postoperative outcomes after primary TKR surgery were reviewed. The combined number of patients included in these studies is 184. Beaupre et al.

assessed the benefits of a preoperative education and exercise program commencing 4 weeks before total knee replacement surgery, whereas Rodgers et al. and D'Lima et al. evaluated the benefit of an exercise program 6 weeks before surgery. All 3 studies report negative findings with regard to the effectiveness of preoperative exercise to improve physical functioning after TKR surgery. However, Beaupre et al. and D'Lima et al. failed to show an effect of the preoperative exercise program before surgery in those patients receiving preoperative exercise. Rodgers et al. did not measure the HSSK score immediately before surgery in the preoperative exercise treatment group; therefore they could not document an effect of the preoperative exercise program before surgery. Regarding health services utilization, both Beaupre et al. and Rodgers et al. did not find significant differences in either the length of the acute care hospital stay or the inpatient rehabilitation care setting. D'Lima et al. did not measure this outcome.

These results must be interpreted within the limitations and the biases of each study. Negative results do not unconditionally support a lack of treatment effect but may be attributed to a type II statistical error. However, if an adequate sample size is used, a negative finding can be attributed to a true result. Beaupre et al. determined a sample size a priori to detect a mean change in the WOMAC physical function score of 10 points with a standard deviation of 18 at a power of 80%. Likewise, D'Lima et al. also completed a sample size a priori, which was predicated on a 10-point difference in the postoperative HSSK rating scores between groups and a reduction in the duration of hospital stay by at least 1 day at a power of 80%. Both studies reported no statistically significant difference in these outcomes. However, given the total sample size of 30 (10/group), D'Lima et al. would need an effect size greater than 1 to detect a difference between 2 group means. As D'Lima does not report the estimated standard deviation used to approximate the sample size, it is unknown whether a total sample size of 30 (10/group) was adequate for a power of 80%. Therefore, the negative findings reported by D'Lima et al. may represent a type II error.

Failure to document an effect of the preoperative exercise program before surgery in all 3 studies questions the adequacy of the preoperative exercise intervention. An inadequate preoperative exercise program may include deficiencies in the type of exercise practiced or the timing or duration of the exercise program before surgery. Inadequacy of the preoperative exercise program possibly accounts for the lack of treatment effect after surgery. No inference can be made from these study results as to the effectiveness of a preoperative exercise program beginning greater than 6 weeks before surgery or one that includes a different exercise regimen.

A GRADE quality of evidence profile is shown in Tables 33, 33a, and 33b for the outcome of physical functioning. The overall quality of evidence is moderate when using the WOMAC to evaluate the effectiveness of a preoperative exercise program beginning 4 weeks before surgery. The overall quality of evidence is low to very low when using a HSSK scale or flexion ROM, respectively, to evaluate the effectiveness of a preoperative exercise program beginning 6 weeks before surgery. Both the HSSK and ROM outcome measures are considered suboptimal outcome measures.

Therefore there is moderate evidence to support the lack of effectiveness of an exercise program beginning 4 weeks before TKR surgery on postoperative physical functioning.

Table 33: GRADE Profile

For question: Should patients be treated with preoperative exercise before TKR surgery?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Comparison (Study)	Design	Quality	Consistency	Directness	Other modifying factors	Preop exercise	No Preop exercise	Relative (95% CI)	Quality	Outcome
Physical Functioning (measured by WOMAC)										
(Beaupre et al. (27))	RCT	Serious Limitation*	1 study	None	None	51	58	Not done	⊕⊕⊖⊖	Critical
Quality GRADE	High	Moderate (-1)	Moderate	Moderate	Moderate				Moderate	

*No intention-to-treat analysis

Table 33a: GRADE Profile

For question: Should patients be treated with a preoperative exercise program before TKR surgery?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Comparison (Studies)	Design	Quality	Consistency	Directness	Other modifying factors	Preop exercise	No Preop exercise	Relative (95% CI)	Quality	Outcome
Physical Functioning (measured by HSSK)										
(Rodgers et al. and D'Lima et al.)	RCT	Serious limitation*	None	Some uncertainty†	None	20	20	Not possible to calculate	⊕⊕⊖⊖	Critical
Quality GRADE	High	Moderate	Moderate	Low	Low				Low	

* No treatment allocation concealment or a priori sample size calculation (Rodgers et al. (28)).

†HSSK is sub optimal outcome measure for physical function

Table 33b: GRADE Profile

For question: Should patients be treated with a preoperative exercise program before TKR surgery?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Comparison (Studies)	Design	Quality	Consistency	Directness	Other modifying factors	Preop exercise	No Preop exercise	Relative (95%CI)	Quality	Outcome
Physical Functioning (measured by ROM)										
Preop exercise vs. no preop exercise (Beaupre et al. and Rodgers et al.)	RCT	Serious limitations*	None	Major uncertainty†	None	61	68	Not possible to calculate	⊕⊖⊖⊖	Critical
Quality GRADE	High	Moderate (-1)	Moderate	Very low (-2)	Very low				Very low	

*No intention-to-treat analysis (Beaupre et al.); no treatment allocation concealment or a priori sample size calculation (Rodgers et al. Rodgers, 1998 761 /id))

† ROM is a suboptimal outcome measure to determine functionality after total joint replacement surgery.

Medical Advisory Secretariat question 3B: What is the effect of a preoperative exercise program on

functional recovery after THR?

Table 34: Primary Studies

Study	Methods	N
Gocen, 2004 (30)	RCT	60
Gilbey, 2003 (29)	RCT	76

To ascertain the quality of the methods, each primary study was assessed using the Cochrane Musculoskeletal Injuries group Methodological Assessment tool (Appendix 4). Scores for each of the 12 criteria are reported in Table 35 after which a descriptive report for each criterion is provided.

Table 35: Included Studies

	Criteria											
	A	B	C	D	E	F	G	H	I	J	K	L
Gocen et al., 2004 (30)	0	1	2	0	0	2	2	2	2	1	1	2
Gilbey et al., 2003 (29)	1	1	0	2	0	0	1	2	2	2	2	1

*All criteria are scored from 0 to 2. See Appendix 4 for the definition of each score for each criterion. **A.** Was the assigned treatment adequately concealed prior to allocation? **B.** Were withdrawals adequately described and included in the analysis (intention-to-treat)? **C.** Were the outcome assessors blinded to treatment status? **D.** Were the treatment and control group comparable at entry? **E.** Were the participants blinded to assignment status after allocation? **F.** Were the treatment providers blinded to assignment status? **G.** Were care programs, other than the trial options, identical? **H.** Were the inclusion and exclusion criteria clearly defined? **I.** Were the interventions clearly defined? **J.** Were the outcome measures clearly defined? **K.** Were diagnostic tests used in outcome assessment clinically useful? **L.** Was the surveillance active and of a clinically appropriate duration?

A. Concealment: Gocen et al. (30) inadequately used an alternating treatment allocation scheme and therefore did not conceal the treatment allocation. Gilbey et al. (29) did not report treatment allocation methodology.
B. Intention-to-treat: Gocen et al. reported 1 withdrawal in the preoperative exercise group (treatment group) and none in the control group (no preoperative exercise). The withdrawal was not accounted for in the statistical analysis. Gilbey et al. reported that 10.5% (8 patients) of the total population withdrew leaving 37 subjects in the treatment group and 31 in the control group. The withdrawals were not accounted for in the statistical analysis.
C. Blinding of outcome assessors: Gocen et al. used an outcome assessor who was blinded to the subject group allocation. Gilbey et al. did not report assessor blinding.
D. Baseline comparability of treatment groups: Gocen et al. reported that subjects in the treatment group were statistically significantly younger ($P = .01$) than those in the control group who did not receive preoperative exercise. This may have occurred because of the inadequate allocation concealment. There was good comparability of groups at baseline in the study by Gilbey et al.
E. Study subject blinding: Blinding of the study subjects to the treatment allocation was not feasible in both studies given the type of intervention (preoperative exercise vs. no preoperative exercise)
F. Treatment provider blinding: Gocen et al. provided postoperative physiotherapy by a physical therapist who was blinded to the allocation of the subject. Gilbey et al did not report treatment provider blinding.
G. Care programs: Gocen et al. used identical treatment programs for the treatment and control groups

other than the intended study intervention. However, Gilbey et al. had 2 notable differences in care programs between the treatment and control groups. First, during the informed consent process, potential subjects familiarized themselves with the exercises and test procedures of the protocol. (29;31) This may have exposed potential control subjects to the study intervention, thereby causing contamination. Second, patients allocated to the treatment group received intensive postoperative exercise beginning 3 weeks after surgery, whereas patients in the control group did not. This confounds the effects of the preoperative exercise program on any postoperative functional outcomes measured 3 weeks or more after surgery.

H. Inclusion and exclusion criteria: Both studies adequately reported inclusion and exclusion criteria.
I. Clearly defined interventions: Both studies clearly defined the study treatment interventions.
J. Clearly defined outcome measures: Gocen et al. did not clearly define the Harris Hip score. However, Gilbey et al. clearly defined the WOMAC.
K. Were diagnostic tests used clinically useful: Gocen et al. used the Harris Hip Scale, and Gilbey et al. used the WOMAC. Both scales are clinically useful to determine physical functioning; however, the WOMAC is considered the clinically optimal outcome measure.
L. Duration of follow-up: Gocen et al. reported data for a 2-year follow-up period; Gilbey et al., for a 6-month follow-up period. A 1-year follow-up period is considered the optimal and minimum duration of follow-up.

Given the above methods assessment, biases and limitations were identified (Table 36).

Table 36: Bias Assessment*

Bias	Gocen et al.	Gilbey et al.
Selection	+++	+
Performance	–	+
Detection	–	+
Attrition	–	+

*No (–) Possible (+) Probable (++) Yes (+++)

Of the 2 studies, the RCT by Gocen et al. has the fewest biases. However, there is significant selection bias, which threatens the validity of the study results.

Description of Primary Studies

It was not possible to synthesize the WOMAC and Harris Hip score data from the studies by Gilbey et al. and Gocen et al. because of significant clinical heterogeneity for the ages of the subjects (Table 37). Therefore, a descriptive report of the results of each primary study is presented. Characteristics of each study can be found in Appendix 2.

Table 37: Study Population Characteristics*

Study	N	Mean (SD) Age, Years	Female, %	Body Mass Index (kg/m^2)	Implant/ Fixation	Diagnosis
Gocen et al., 2004 (30)	60	46.9 (11.48) treatment 55.5 (14.44) control	44.8 treatment 26.7 control	24.9 (SD, 3.7) treatment 27.7 (SD, 3.7) control	Thrust plate prosthesis /cementless acetabular component.	29 subjects with primary osteoarthritis of the hip 30 subjects with secondary osteoarthritis of the hip: 13 with development dysplasia, 10 with idiopathic avascular necrosis of the hip, 7 with hip fractures No subject had received physiotherapy for hip osteoarthritis previously.
Gilbey et al., 2003 (29)	76	66.7 (10.2) treatment 63.3 (2.0) control	30.9 treatment 30.9 control	27.7 (SD, 4.78) treatment 28.2 (SD, 3.60) control	Posterior surgical approach in 55 subjects and lateral surgical approach in 13 subjects Type of implant and fixation not reported.	59 had degenerative osteoarthritis. Other conditions were post-traumatic osteoarthritis, inflammatory arthritis, osteonecrosis of the femoral head and Paget's disease.

*Treatment was preoperative exercise; control was no preoperative exercise.

Table 38: Study Treatments

Study	Treatment	Control	Co-interventions
Gocen et al., 2004 (30)	Patients were told to do specific exercises including straight leg raises, stretching of hamstrings and hip flexors, and upper extremity strengthening exercises. A physiotherapist evaluated subjects every 2 weeks. This group also received an education program including advice on movements that should be avoided, use of devices such as crutches, elevated toilet seats, elevated beds and forceps to help in dressing and undressing, posture, lifting and carrying, washing and bathing. Frequency of treatment: 3 times/day for 8 weeks.	No preoperative exercises or education program was given to the control group.	Both groups received the same postoperative educational program starting on day 1. A physiotherapist blinded to the treatment assignment did the postoperative treatment on all patients in this study.
Gilbey et al., 2003 (29)	Subjects had to complete 2 supervised clinic-based and 2 home-based exercise sessions before surgery. The clinic session was about 1 hour with 30 minutes of aerobic exercise and strength training and 30 minutes of mobility and gait training in the hydrotherapy pool. The clinic program also included a 5-minute warm-up on a cycle, arm, or rowing ergometer, heel raises, leg flexion and extension exercises, thigh flexion and extension exercises, and isometric thigh abduction exercises. Trunk flexion and trunk rotation, forearm curls, seated body raises, and hip hikes were also completed. Isotonic exercises included 1 set of 10 repetitions, rising to 3 sets of 10 repetitions as the patient improved. During the first clinic session, patients were instructed in the home-based exercise program. The home program was tailored to each patient depending on level of mobility, degree of pain, age, and the amount of help at	No additional exercise other than routine in-hospital physical therapy was given to the control group.	All patients became familiar with the test procedures before random allocation was done.

Study	Treatment	Control	Co-interventions
	home. Patients were given an instruction booklet and log-book in which to record their home exercise sessions. The log-books were completed each week and were used to monitor the patient's compliance with the home exercise program. 3 weeks postoperatively, patients returned to the clinic and continued a clinic-based exercise program until 12 weeks after surgery. Participation beyond 12 weeks postoperatively was optional. Patients were encouraged to continue practicing the exercise routine at home. Frequency of treatment. 4 sessions (2 clinic, 2 home-based)/week for 8 weeks before surgery.		

Table 39: Study Outcome Measures

Study	Physical Functioning	Pain	Stiffness	Global Assessment	Quality of Life	Length of Follow-up
Gocen et al., 2004 (30)	Harris Hip score (0 = extreme difficulty; 100 = no difficulty) Number of days to start walking, climbing stairs, transferring activities Range of hip abduction	Visual Analogue Scale (VAS)	Not assessed	Not assessed	Not assessed	Baseline,* immediately† preoperatively, at discharge, postoperatively at 3 months and 2 years
Gilbey et al., 2003 (29)	WOMAC (0 points = no difficulty with physical functioning; 4 = extreme difficulty with physical functioning), Total WOMAC score (0 = best functioning; 100 = worst functioning) Strength of bilateral thigh flexor and extensor muscles, isometric thigh abduction strength, hip flexion ROM	WOMAC (0 = no pain; 4 = extreme pain)	WOMAC (0 = no stiffness; 4 points = extreme stiffness)	Patient satisfaction questionnaire	Not assessed	Baseline (8 weeks before surgery) Preoperatively 1 week before surgery Postoperatively at 3 weeks, 12 weeks and 24 weeks

*Harris Hip Score baseline measurement taken 8 weeks before surgery in preoperative exercise group (treatment group) only.
†Harris Hip Score measurement taken in treatment and control groups immediately preoperatively.

Gocen al., 2004

Gocen et al. (30) did an RCT to determine the effectiveness of a preoperative exercise program for patients having primary hip replacement surgery. Table 37 describes the study population characteristics, Table 38 the treatment interventions, and Table 39 the outcome measures. Patients were randomized to either a preoperative exercise training and education program (treatment) beginning 8 weeks before surgery or no preoperative exercise training or education before surgery (control).

Twenty-nine patients were evaluated in the treatment (preoperative exercise) group, and 30 patients were evaluated in the control group (no preoperative exercise). Length of hospital stay, body mass index, and

male to female ratio within groups did not differ between groups. However, people were significantly younger in the preoperative exercise treatment group than in the control group ($P = .01$).

In the treatment group, the mean Harris Hip Score improved significantly from baseline (8 weeks before surgery) to immediately before surgery (Table 40) ($P = .001$). However, Gocen et al. did not measure a baseline Harris Hip score 8 weeks before surgery in the control group; therefore, any significant difference in improvement during this period cannot be assessed, and the adequacy of the intervention (preoperative exercise) cannot be determined. This is important considering the Harris Hip scores immediately preoperatively in both groups did not differ significantly between groups (Table 40). There was no difference between groups in the change in the Harris Hip score measured immediately preoperatively and at measured 3 months and 2 years after surgery.

The first day to perform ADL successfully, which included walking, stair climbing, and transfer activities, was recorded. While people in the treatment group were able to perform transfer activities, including transfer from the bed, toilet and chair, and climb stairs about 1 day earlier than those in the control group, multiple t-tests were done for this analysis without adjusting the level of statistical significance. This increases the chance of a type I statistical error (finding a difference due to chance alone). If a Bonferroni correction is used to adjust for the multiple t-tests, then the level of significance would be reduced to .01 (.05/5), and only stair climbing and chair transfer would be significant (Table 41). However, the clinical significance of performing any of the activities 1 day earlier is unknown.

Table 40: Harris Hip Scores*

Assessment Period	Treatment Group N = 29 Mean (SD)	Control Group N = 30 Mean (SD)
Baseline (8 weeks before surgery)	42.7 (16.9)	Not assessed
Immediately before surgery	51.4 (18.30)†	45.3 (12.98)
3 months	85.3 (11.78)	78.7 (9.41)
2 years	97.14 (4.32)	95.66 (6.08)

*Lower score indicates decreased functioning.
†$P = .001$ for postexercise treatment scores compared with baseline scores in treatment group.

Table 41: Activities of Daily Living

Activity of Daily Living	Treatment Group (Days) Mean (SD)	Control Group (Days) Mean (SD)	*P*
Climbs stairs	6.17 (1.69)	7.37 (1.02)	.01*
Bed transfer	2.93 (0.59)	3.33 (0.71)	.02
Toilet transfer	4.24 (0.51)	5.07 (1.28)	.02
Chair transfer	4.24 (0.74)	5.60 (4.45)	.001*

*Only significant ADL variables if the level of significance is adjusted because of multiple comparisons to $P = .01$ using a Bonferroni correction.

Two superficial infections were reported, 1 in each group, which resolved with local wound care and did not impede the rehabilitation process.

Conclusions

Gocen et al. concluded that there is no major benefit of a preoperative physiotherapy and education program beginning 8 weeks before primary hip replacement surgery.

Gilbey et al., 2003

Gilbey et al. (29) did an RCT to determine the effects of a customized preoperative and postoperative exercise program on functional recovery and muscular strength after primary hip replacement. Table 37 describes the study population characteristics, Table 38 the treatment interventions, and Table 39 the outcome measures. Patients were randomized to receive either a customized preoperative exercise training program beginning 8 weeks before surgery and an intensive clinic-based exercise program beginning 3 weeks after surgery for 9 weeks (treatment) or no preoperative exercise program or intensive postoperative exercise program (control condition)

Thirty-seven people were evaluated in the preoperative exercise (treatment) group, 31 in the no preoperative exercise (control) group. Baseline parameters including sex, age, height, body mass index, number of comorbid conditions, hip strength, hip flexion ROM, and ratings on the self-assessment questionnaire did not differ between groups.

Both groups were evaluated at 8 weeks (baseline) and 1 week before surgery, and then at 3, 12 and 24 weeks after surgery. The difference in scores between groups 1 week preoperatively supports the adequacy of the study intervention. The total WOMAC scores differed significantly between groups at 1 week before surgery ($P < .05$), and at 3 ($P < .05$), 12 ($P < .01$) and 24 weeks after surgery ($P < .01$) (Table 42). Additionally, the treatment group was walking 18 meters further at 12 weeks than was the control group at 24 weeks

Table 42: Total WOMAC Scores*

Assessment Period	Preoperative Exercise Group N = 37 Mean (SD)	Control Group N = 31 Mean (SD)
Baseline (8 weeks before surgery)	50 (3)	50 (3)
Post exercise treatment (1 week before surgery)	42 (3)†	52 (4)
3 weeks	25 (2)†	35 (2)
12 weeks	11 (2)‡	21 (2)
24 weeks	8 (2)‡	15 (2)

*Higher score indicates decreased functioning; scores are estimates from graphic presentation of results in Gilbey et al. 2003 (29)
†$P < .05$ preoperative exercise treatment group vs. control group.
‡$P < .01$ preoperative exercise group vs. control group.

Gilbey et al. used a self-assessment questionnaire with statements ranging from much better to much worse to measure global assessment of treatment effectiveness. The questionnaire included questions on pain and level of general health and was done 8 weeks before surgery (baseline), before the exercise program began, and at 1 week before surgery, after the exercise program was completed. Sixty-three percent of patients in the preoperative exercise group rated their general level of pain as somewhat better or much better 1 week before surgery than at baseline, compared with 13% in the control group. Sixty-seven percent of patients in the exercise group rated their general health as much better or somewhat better 1 week before surgery, compared with 26% of the control subjects. The authors did not report statistical significance of these results.

Patients in the treatment group had significantly increased combined hip strength scores (combined scores for thigh flexion, extension, and hip abduction) at 1 week preoperatively ($P < .05$), and 12 ($P < .05$) and 24 weeks postoperatively ($P < .05$) compared to the patients in the control group.

Greater ROM scores were noted for subjects in the treatment group at 1 week before surgery ($P < .05$), and 3 ($P < .05$), 12 ($P < .01$), and 24 weeks ($P < .01$) postoperatively.

Conclusions

Gilbey et al. concluded that a preoperative exercise program beginning 8 weeks before hip replacement surgery improves levels of pain, stiffness, physical function, hip flexion ROM, and muscle strength in patients with end-stage hip disease. Furthermore, postoperative exercise rehabilitation maintained the functional advantage for 6 months after surgery.

It is important to note that in addition to the preoperative exercise treatment, the preoperative exercise treatment group also received an intensive postoperative exercise program beginning 3 weeks after surgery that the control group did not receive. Given this, it is difficult to attribute the differences in postoperative outcomes beyond 3 weeks postoperatively to the preoperative exercise alone. However, both total WOMAC scores and ROM were statistically significantly different between groups at 1 week before surgery and 3 weeks postoperatively, which supports the effectiveness of the preoperative exercise.

Summary and Overall Quality of Evidence

Two studies testing the effectiveness of preoperative exercise on postoperative functional outcomes after primary THR surgery were reviewed. The number of patients in both studies was 136. The study by Gocen et al. did not support the effectiveness of an exercise program beginning 8 weeks before surgery. However, results reported by Gilbey et al. did support the effectiveness of an exercise program 8 weeks before primary THR surgery on pain and functional outcomes 1 week before and 3 weeks after surgery.

A GRADE quality of evidence profile is shown in Tables 43 and 43a for the outcome of physical functioning. The overall quality of the RCT evidence for the outcome of physical functioning is moderate when measured using the WOMAC and low when measured with the HSSK scale.

Therefore, there is moderate evidence to support the effectiveness of an exercise program beginning 8 weeks before primary hip replacement surgery on physical functioning 1 week before and 3 weeks after primary hip replacement surgery.

Table 43: GRADE Profile

Should patients be treated with a preoperative exercise program before total hip replacement surgery?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Comparison (study)	Design	Quality	Consistency	Directness	Other modifying factors	Preop exercise (treatment)	No Preop exercise (control)	Relative (95%CI)	Quality	Outcome
Physical Functioning (measured by WOMAC)										
(Gilbey et al. (29))	RCT	Serious limitations*	1 study	None	None	37	31	N/A	⊕⊕⊕○	Critical
Quality GRADE	High	Moderate (-1)	Moderate	Moderate	Moderate				Moderate	

*No intention-to-treat analysis

Table 43a: GRADE Profile

Should patients be treated with a preoperative exercise program before total hip replacement surgery?

Quality Assessment						Summary of Findings				
						No. of Subjects		Effect		
Comparison (Study)	Design	Quality	Consistency	Directness	Other modifying factors	Preop exercise (treatment)	No Preop exercise (control)	Relative (95%CI)	Quality	Outcome
Physical Functioning (measured by HSSK)										
(Gocen et al. (30))	RCT	Serious limitations*	1 study	Some uncertainty in directness†	None	29	30	N/A	⊕⊕○○	Critical
Quality GRADE	High	Moderate (-1)	Moderate	Low (-1)	Low				Low	

*No treatment allocation concealment, probable selection bias
†HSSK considered a suboptimal outcome measure

Economic Analysis

Disclaimer: This economic analysis represents an estimate only, based on assumptions and costing methodologies that have been explicitly stated. These estimates will change if different assumptions and costing methodologies are applied to develop implementation plans for the technology.

Budget Impact Analysis

Of 18,860 planned primary total joint replacements during fiscal year 2003 (1), the Medical Advisory Secretariat assumes that about 50% (i.e., 9,430) of the patients will have been rehabilitated in hospital, and the others (i.e., 9,430) at home under the direction of staff funded through a CCAC. Depending on whether the rehabilitation in hospital occurs primarily while the patient occupies a post-acute specialty bed or a post-acute general bed, the annual cost of rehabilitation will range in Canadian (Cdn.) dollars from about $28.3 million[1] to $42.4 million.[2] Providing outpatient home-based rehabilitation currently costs the Ministry of Health and Long-Term Care about $14.1 million Cdn. annually.[3]

Cost-Effectiveness

Based on administrative discharge data from joint replacement patients in Ontario in the early 1990s, Coyte et al. (32) found that the lowest hospital readmission rate was for those discharged to a rehabilitation hospital rather than home-based rehabilitation.[4] However, this benefit came at an additional cost. He estimated that the incremental cost was between $288,210 and $611,634 Cdn. per readmission avoided[5] when the discharge strategy was switched from either of the 2 home discharge strategies to the rehabilitation-hospital-only strategy. He also observed that those who had outpatient home care in addition to inpatient rehabilitation had higher readmission rates and treatment costs than those who received inpatient rehabilitation only.

A recent randomized study (33;34)from the United Kingdom found that home-based rehabilitation was about £650 (or $1,500 Cdn) less expensive per case to treat than inpatient rehabilitation with little difference in final outcomes aside from less joint stiffness in the home care group ($P = .03$). An earlier randomized trial (35) of total hip and knee replacement patients from the UK contradicted this finding. The results indicated no difference in overall treatment costs between hospital and home-based rehabilitated patients, noting only a longer duration of rehabilitation for home care patients (15 days vs. 12 days, $P < .05$).

Cost-savings from shift of current rehabilitation strategy: 50% to 80% home rehabilitation
If the province were to increase the share of home-based rehabilitation to 80% of total joint replacement

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[1] approximately 10 days x $300 per day per case x 9,430 cases based on the Ontario Cost Distribution Methodology data, April 2002.
[2] approximately 10 days x $450 per day per case x 9,430 cases based on the Ontario Cost Distribution Methodology data, April 2002.
[3] $1,500 per case x 9,430 cases
[4] Coyte et al. (32) compared 4 different hospital discharge strategies: 1. rehabilitation hospital only, 2. rehabilitation hospital + some home care rehabilitation afterward, 3. home care rehabilitation only, 4. home discharge without rehabilitation
[5] There would be between 81 and 141 fewer readmissions per 10,000 procedures performed after switching to a strategy of rehabilitation hospital only.
[6] Because hospitals in Ontario are funded under multi-year global budgets, the added cost of readmissions may never be realized by the ministry, as the care these patients receive will just be displacing other types of care provided.

cases, then it could expect a net savings of between $8.5 million and $16.9 million Cdn. annually owing to the lower cost of home-based rehabilitation ($1,500 Cdn. per case for CCAC-provided home-based rehabilitation vs. $3,000–$4,500 Cdn. per case for inpatient rehabilitation). However, the shift from inpatient to home-based rehabilitation may produce some adverse dynamics leading to an increase in hospital readmissions as observed by Coyte et al.; (32) therefore, the total savings might be somewhat less owing to the cost associated with treating those who are readmitted to hospital.[6]

Appraisal/Policy Development

Policy Considerations

A description of physiotherapy service providers in Ontario is outlined below.

Inpatient Physiotherapy Services

There were 68 inpatient rehabilitation facilities staffed and in operation in 2003/04 (Appendix 5). The National Rehabilitation Reporting System classifies each facility as either a general or specialty facility. A general rehabilitation facility is "a rehabilitation unit or collection of beds designated for rehabilitation purposes that is part of a general hospital offering multiple levels or types of care." A specialty facility is "one that provides more extensive an specialized inpatient rehabilitation services and is commonly a freestanding facility or a specialized unit within a hospital." (36)

These 2 facility classifications can also be described in terms of the types of services offered (Personal communication, CIHI, June 6, 2005). For example, a general facility might have physiotherapists and/or occupational therapists and would see general types of clients, whereas a specialized unit would have several types of rehabilitation professionals like physiatrists, social workers, and orthotists, and would focus on specific conditions such as stroke, spinal cord injuries, or orthopedic conditions.

Total joint replacement patients fall under the musculoskeletal rehabilitation program definition developed by the Ontario Hospital Working Group in March 1999, which is defined as "a program designed to provide rehabilitation to patients with an injury or disorder/disease of bone, joint or muscle and/or other systemic diseases whose course or complication result in musculoskeletal impairments."

- The primary reason for referring total joint replacement patients to an inpatient rehabilitation facility is for intensive physiotherapy and./or occupational therapy after surgery. Inpatient rehabilitation provides physiotherapy for about 1 hour at a time (Personal communication, clinical expert, March 2, 2005). As well, other rehabilitation services including physician and nursing care, recreational therapists, dieticians, social work, and pharmacist services are also available.
- In 2001/02 the mean acute care length of stay for primary total joint replacement surgery patients was 5.6 days (median, 5) for patients transferred to an inpatient rehabilitation facility compared with 6.4 days (median, 6) for patients discharged directly home. (2)
- In 2001/02 the length of stay in an inpatient rehabilitation facility for primary THR and TKR surgery patients was 11.8 days and 11.0 days respectively. (2)

Outpatient Physiotherapy Rehabilitation Services

After primary total knee or hip replacement surgery, patients who are discharged directly home and require physiotherapy may receive care in their home offered through a CCAC, in a designated Ontario Health Insurance Plan (OHIP) physiotherapy clinic, (Appendix 6) or at an outpatient rehabilitation clinic at an acute care hospital. Additionally, patients may obtain services through a private health care plan.

Community Care Access Centres

There are 43 CCACs across Ontario providing several services to total joint replacement patients including personal support and home-making services (e.g., help with bathing, dressing, making meals), nursing services for postoperative wound care, and rehabilitation services including physiotherapy and occupational therapy. A requirement for eligibility for services includes the need for in-home care.

The CCAC regulates the maximum number of personal support and home-making services a client may receive. However, there is no upper limit for physiotherapy and/or occupational therapy services (Personal communication, Ministry of Health and Long-Term Care, Community Health Division, Home Care and Community Support, June 8, 2005).

Funding was released from the Health Results Team to the CCACs in response to the ministry's hip and knee waiting time strategy program. One thousand Canadian dollars per case was given to CCACs for 1422 new total joint or hip cases in 2004/05. This funding has since been increased to $1500 Cdn. per case for 6700 new cases in 2005/06 (Personal communication, Ministry of Health and Long-Term Care, June 8, 2005). This amount represents the estimated CCAC costs to provide all necessary services to a total joint replacement patient after surgery.

The Management Information System of the ministry is tracking all new total joint replacement clients serviced by the CCAC. Data will not reflect patients that have partial knee replacements (Personal communication, Ministry of Health and Long-Term Care, Community Health Division, Home Care and Community Support, June 8, 2005).

Future ministry plans include the development of standard clinical pathways to improve services between hospitals and CCACs for patients who receive total joint replacement surgery (Personal communication, Ministry of Health and Long-Term Care, Community Health Division, Home Care and Community Support, June 8, 2005).

Designated Physiotherapy Clinics

People who have total joint replacement surgery who require rehabilitation services may receive physiotherapy services from a designated physiotherapy clinic (Appendix 6). OHIP covers services provided by these designated clinics. Most are located in the central part of the province.

People over the age of 65 years who have total joint replacement surgery and that need physiotherapy after surgery may receive OHIP-insured services from a designated physiotherapy if ordered by a physician. People between the ages of 20 and 64 years may receive OHIP insures ervices from a designated physiotherapy clinic if the following conditions as outlined in the Health Insurance Act – R.R.O., 1990, Reg. 552 are met:

- The physiotherapy services are ordered by a physician on the medical staff of a hospital,
- The services are provided to an insured person following his or her discharge as an inpatient of that hospital,
- The services are directly connected to the condition, illness, or injury for which the insured person was admitted to the hospital, and
- The services are rendered at a designated physiotherapy clinic by a designated physiotherapist.

Also, physiotherapy services may be covered by OHIP if the following conditions are met:

- The services are ordered by a physician,

- The services are provided to an insured person in his or her home by a designated physiotherapist, and,
- The services are required to be rendered in the insured person's home because of the insured person's condition, illness, or injury.

Based on Ministry of Health and Long-Term Care Provider Services Branch data, about 599 of 5,320 THR patients and 892 of 7,198 total joint replacement patients aged over 65 years received OHIP-covered physiotherapy services postoperatively during fiscal year 2003/04. Total OHIP physiotherapy service fees paid were $171,123.20 Cdn. for those having THR and $267,802.20 Cdn. for those having total knee replacement.

Hospital Outpatient Clinics

Outpatient physiotherapy services are also provided at outpatient rehabilitation clinics attached to an acute care hospital. Funding is provided through the hospital's global budgets. The number and location of existing hospital outpatient clinics is not known (Personal communication, Integrated Policy and Planning Division, Ministry of Health and Long-Term Care, June 7, 2005).

Integration of Clinical Care Pathways

The Toronto Joint Network Integrated Model of Care for total joint replacement received 2-year funding from the ministry in April 2005 to evaluate a clinical pathway for joint replacement care. This model is a collaborative approach involving the acute care hospitals, rehabilitation hospitals, and CCACs in the Greater Toronto Area, as well as the Greater Toronto Area Rehab Network, Ontario Joint Replacement Registry, and The Arthritis Society, Ontario Division. The integrated model of care aims to increase capacity within the current health care system to reduce waiting times. This project will achieve this by reducing the total length of stay in the system and by improving the integration of the patient's experience across the continuum of care. Figures 4 and 5 outline the current and proposed Toronto Joint Network Integrated Model of Care respectively (Final Report, Toronto Hip and Knee Replacement Task Force, May 17, 2005)

Figure 4: Current Model

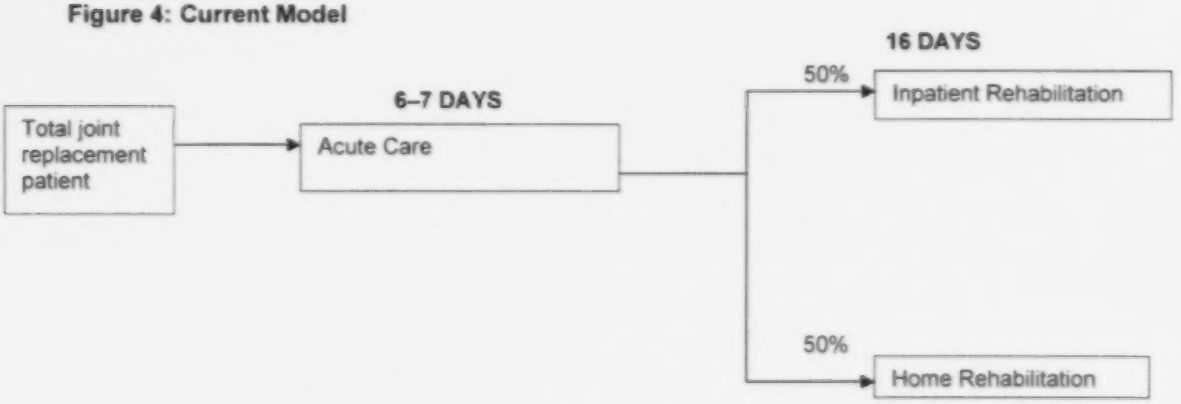
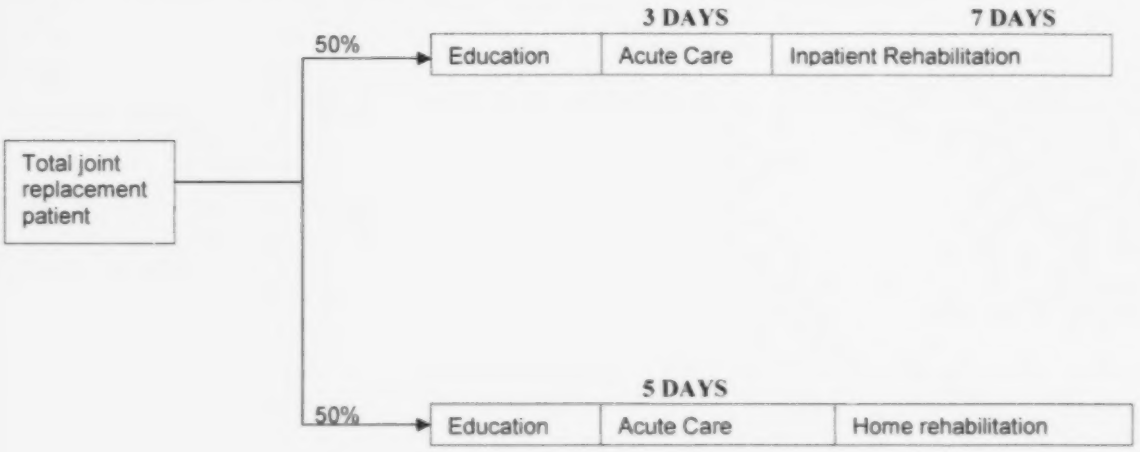


Figure 5: Proposed Toronto Joint Network Integrated Model of Care (GTA)



The model has been divided into 2 streams: an expedited inpatient rehabilitation stream and an expedited home care rehabilitation stream. Patients will be selected to participate in 1 of the streams. Selection criteria are based on home support, comorbidity severities, and the degree of walking ability before surgery. Patients with lack of home support, who have a significant medical comorbidity, such as coronary heart disease, or who cannot walk 1 city block before surgery will be sent to the expedited inpatient rehabilitation stream. Both streams will receive preoperative education.

Patients in the inpatient rehabilitation stream will have a 3-day acute care stay and a 7-day inpatient rehabilitation stay. The goal is to discharge these patients home without any additional CCAC services 10 days after their surgery. Patients in the expedited home care rehabilitation stream will have a 5-day acute care stay after which they will be discharged to home with care provided by their respective Toronto or surrounding regional CCAC providers.

Proposed Benefits of Toronto Joint Network Integrated Model

The model will increase accessibility by doing the following:

- Increasing the total number of primary hip and knee replacement patients treated
- Increasing utilization rates
- Reducing waiting times for surgery
- Realizing cost-savings and efficiencies through reduced lengths of stay in acute care and rehabilitation hospitals and lower costs per patient (because of reduced length of stay)
- Improving integration and seamlessness of care by having a standardized care pathway across the continuum that will reduce variation.

Conclusions

Based on the evidence, the Medical Advisory Secretariat reached the following conclusions with respect to physiotherapy rehabilitation and physical functioning 1 year after primary TKR or THR surgery:

- There is high-quality evidence from 1 large RCT to support the use of home-based physiotherapy instead of inpatient physiotherapy after primary THR or TKR surgery.
- There is low-to-moderate quality evidence from 1 large RCT to support the conclusion that receiving a monitoring phone call from a physiotherapist and practising home exercises is comparable to receiving clinic-based physiotherapy and practising home exercises for people who have had primary TKR surgery. However, results may not be generalizable to those who have had THR surgery.
- There is moderate evidence to suggest that an exercise program beginning 4 to 6 weeks before primary TKR surgery is not effective.
- There is moderate evidence to support the effectiveness of an exercise program beginning 8 weeks before surgery to improve physical functioning 3 weeks after THR surgery.

Glossary

Acetabulum:	The large cup shaped cavity (hip socket) into which the head of the femur (thigh bone) fits to create the hip joint.
Arthroplasty	A surgical procedure on a joint often to remove the diseased joint an insert an artificial one.
Arthrosis	A joint.
Articular Cartilage	The fibrous connective tissue of a joint
Effect Size	A dimensionless measure of the estimate of the effect of a treatment. It is usually calculated by taking the difference in the means between the study treatment and control groups then dividing the result by the standard deviation (variability) of the control or both groups.
Intention to treat	A method of analyzing data from a randomized controlled trial (RCT) in which the study participants are included in the treatment group to which they were allocated, whether or not they received or completed the study treatment. This method is used to prevent bias due to the loss of study participants.
Reliability:	The degree to which results obtained by a measurement procedure can be replicated. Validity: The degree to which the results of a study are likely to be true and free of error (bias).
Range of Motion	The movement of a joint through its full range of normal movements. The movement can be active (voluntary contraction and relaxation of the muscles) or passive (outside force causing
Goniometer	An instrument used to measure angles of joint motion.

Appendices

Appendix 1: Literature Search Strategy

Search date: March 18, 2005
Databases searched: Ovid MEDLINE, MEDLINE In Process & Other Non-Indexed Citations, Cumulative Index to Nursing & Allied Health Literature (CINAHL), Excerpta Medica database (EMBASE), Cochrane Database of Systematic Reviews (DSR) and Cochrane Central Register of Controlled Trials (CENTRAL), The International Network of Agencies for Health Technology Assessment (INAHTA), Physiotherapy Evidence Database (PEDro).

Search Strategy – Rehabilitation after Hip and Knee Replacement

Database: Ovid MEDLINE(R) <1966 to March Week 4 2005>
Search Strategy:
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1 exp arthroplasty, replacement/ or exp arthroplasty, replacement, hip/ or exp arthroplasty, replacement, knee/ (8937)
2 exp Physical Therapy Techniques/ (101061)
3 exp Physical Therapy Department, Hospital/ (266)
4 (physiotherap$ or physio).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (7447)
5 or/2-4 (105001)
6 1 and 5 (192)
7 exp REHABILITATION/ or exp REHABILITATION NURSING/ or exp REHABILITATION CENTERS/ (153056)
8 rh.fs. (99496)
9 or/7-8 (222309)
10 exp Patient Care Team/ (34806)
11 exp comprehensive health care/ (120393)
12 exp Holistic Health/ (4331)
13 exp Disease Management/ (3894)
14 exp Clinical Protocols/ (69308)
15 exp Critical Pathways/ (2308)
16 exp Patient Care Planning/ (35465)
17 (multidisciplinary or collaborat$ or comanagement or co-management).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (46619)
18 or/10-17 (261527)
19 9 and 18 (16399)
20 1 and 19 (53)
21 6 or 20 (227)
22 exp Ambulatory Care/ (33329)
23 exp Aftercare/ (4886)
24 exp Postoperative Care/ (37647)
25 exp Home Care Services/ (28481)
26 exp Occupational Therapy/ (5926)
27 exp Exercise Therapy/ (13266)
28 exp Program Evaluation/ (25346)

29 exp Manipulation, Osteopathic/ (69)
30 exp occupational therapy department, hospital/ or exp outpatient clinics, hospital/ (11398)
31 exp Exercise Therapy/ (13266)
32 exp Dietetics/ (3270)
33 exp Social Work/ (9928)
34 exp Allied Health Personnel/ (30625)
35 prosthetist$.mp. (124)
36 orthotist$.mp. (59)
37 or/22-36 (195228)
38 1 and 9 and 37 (154)
39 21 or 38 (279)
40 limit 39 to (humans and yr=1995-2005) (276)
41 limit 40 to (case reports or comment or editorial or letter) (33)
42 40 not 41 (243)
43 exp PAIN/pc [Prevention & Control] (11680)
44 exp Pain, Postoperative/pc [Prevention & Control] (3943)
45 ((pain adj 2 manage$) or (pain adj2 control)).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (6005)
46 or/43-45 (16825)
47 5 or 9 or 18 or 37 (633670)
48 46 and 47 (2959)
49 1 and 48 (36)
50 limit 49 to (humans and english language and yr=1995 - 2005) (35)
51 42 or 50 (269)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to April Week 1 2005>
Search Strategy:
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1 exp arthroplasty, replacement/ or exp arthroplasty, replacement, hip/ or exp arthroplasty, replacement, knee/ (1733)
2 exp Physical Therapy/ (25924)
3 (physiotherap$ or physio).mp. [mp=title, subject heading word, abstract, instrumentation] (4538)
4 1 and (2 or 3) (200)
5 exp REHABILITATION/ or exp REHABILITATION NURSING/ or exp REHABILITATION CENTERS/ (57961)
6 rh.fs. (18546)
7 or/5-6 (66879)
8 exp holistic care/ or exp multidisciplinary care team/ (8861)
9 exp Critical Path/ (1769)
10 exp Disease Management/ (1604)
11 (multidisciplinary or collaborat$ or comanagement or co-management).mp. [mp=title, subject heading word, abstract, instrumentation] (25122)
12 or/8-11 (28716)
13 1 and 7 and 12 (36)
14 exp Ambulatory Care/ (2336)
15 exp After Care/ (1691)
16 exp Postoperative Care/ (4461)
17 exp Home Health Care/ (16506)
18 exp Occupational Therapy/ (6470)

19 exp Program Evaluation/ (6598)
20 exp Outpatient Service/ (1346)
21 exp Therapeutic Exercise/ (10546)
22 exp Social Work/ or exp social workers/ (3993)
23 exp Allied Health Personnel/ (26530)
24 prosthetist$.mp. (59)
25 orthotist$.mp. (51)
26 osteopathic manipulation.mp. or exp Osteopathy/ (487)
27 exp DIETETICS/ or exp Dietitians/ (1847)
28 or/14-27 (76786)
29 1 and 28 (274)
30 4 or 13 or 29 (359)
31 limit 30 to (english and yr=1995 - 2005) (300)
32 limit 31 to (case study or editorial or letter or "review") (45)
33 31 not 32 (255)

Database: EMBASE <1980 to 2005 Week 14>
Search Strategy:
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1 exp total hip prosthesis/ or exp total knee replacement/ (14701)
2 exp physiotherapy/ (16229)
3 (physiotherap$ or physical therap$ or physio).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name] (21673)
4 1 and (2 or 3) (274)
5 exp rehabilitation/ (68333)
6 exp REHABILITATION MEDICINE/ or exp REHABILITATION CENTER/ (4326)
7 rh.fs. (33115)
8 or/5-7 (95388)
9 exp cooperation/ or exp teamwork/ (9089)
10 (multidisciplinary or collaborat$ or comanagement or co-management).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name] (36392)
11 9 or 10 (43876)
12 1 and 8 and 11 (9)
13 exp Ambulatory Care/ (9568)
14 exp Aftercare/ (154483)
15 exp Postoperative Care/ (12956)
16 exp Home Care/ (11434)
17 exp Occupational Therapy/ (4677)
18 exp Health Care Quality/ (448094)
19 exp Outpatient Care/ (7518)
20 exp Kinesiotherapy/ (11235)
21 exp Social Worker/ (1515)
22 exp Social Work/ (3926)
23 exp Dietitian/ (1158)
24 exp DIETETICS/ (618)
25 exp Manipulative Medicine/ (4777)
26 prosthetist$.mp. (101)
27 orthotist$.mp. (57)
28 or/13-27 (602423)
29 1 and 8 and 28 (442)

30 4 or 12 or 29 (646)
31 limit 30 to (human and english language and yr=1995-2005) (478)
32 limit 31 to (editorial or letter or note) (22)
33 Case Report/ (832396)
34 31 not (32 or 33) (419)
35 from 34 keep 201-388 (188)
36 ((pain adj2 manage$) or (pain adj2 control)).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name] (11386)
37 exp Postoperative Pain/pc, rh, th [Prevention, Rehabilitation, Therapy] (1958)
38 exp PAIN/pc, rh, th [Prevention, Rehabilitation, Therapy] (19307)
39 or/36-38 (28703)
40 39 and (2 or 3 or 8 or 11 28.mp.) [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name] (5665)
41 1 and 40 (40)
42 limit 41 to (human and english language and yr=1995 - 2005) (33)
35 or 42 (213)

Appendix 2: Characteristics of Included Studies

Study	Mahomed et al., 2004 (19;20)
Methods	Study Design: randomized controlled trial Method of randomization: block randomization Assessor blinding: no Intent-to-treat analysis: yes Lost to follow-up: no data
Participants	Toronto, Canada N = 234 Inclusion criteria: primary total hip replacement or total knee replacement, living in metro Toronto, Ontario, Canada Exclusion criteria: revision of total hip or tota' knee replacement, bilateral total joint replacements, fractures, and tumors. Sex: 35% male Mean age (years): 67 Assigned: 115/119 (outpatient home-based rehab/inpatient rehab) Assessed: no data
Interventions	Rehabilitation setting: patients were randomized to either outpatient home-based or inpatient rehabilitation after total joint replacement surgery. Standardized care pathways were followed for both groups.
Outcomes	Primary outcomes were self-reported WOMAC pain and function scores and patient satisfaction in terms of improvement in pain and function.
Notes	Study results have been presented in an abstract form only. Full publication is pending. Details of methods and participants were obtained from author.
Allocation concealment	No data

Study	Kelly et al., 1999 (21)
Methods	Study Design: non-randomized controlled trial Treatment allocation: patients self-selected rehabilitation location. Assessor blinding: no. Self-rating questionnaire. Data collected by the primary investigator via a phone call to the patient. Intent-to-treat analysis: no. Reason for withdrawal described but data not reported. Withdrawals not accounted for in analysis. Lost to follow-up: 3 patients in the home physiotherapy group were unavailable for follow-up; 1 patient in the inpatient rehabilitation group was diagnosed with acute leukemia and was dropped from the study. Total losses were 4% of study population.
Participants	Community hospital in Washington, DC, United States N = 100 Inclusion criteria: elective primary unilateral total joint arthroplasty (hip or knee) Exclusion criteria: bilateral arthroplasty, unavailable for preoperative interview, no consent Sex: 35% male Mean age (years): home-based physiotherapy 64±11.6; inpatient rehabilitation 71.5±8.7 Treatment allocation: 68/32 (home-based physiotherapy/inpatient rehabilitation) Data reported for: 65/31 (home-based physiotherapy/inpatient rehabilitation)
Interventions	Rehabilitation setting: Consent to participate was obtained before surgery. Postoperatively all patients adhered to a total hip or total knee critical pathway while in the acute care setting. Patients selected their post-acute recovery setting, which was either home with home physical therapy supervision or an inpatient rehabilitation facility.
Outcomes	Self-Administered Joint Rating Questionnaire
Notes	Primary arthroplasty (confirmed with author April 18, 2005). Variables including age, living arrangements (alone or not), and comorbid conditions that were derived from a discriminant analysis were used as covariates in the statistical analysis.
Allocation concealment	C = clearly no.

Study	Rajan et al., 2004 (22)
Methods	Study Design: randomized controlled trial Method of randomization: random numbers table Assessor blinding: Yes Intent-to-treat analysis: no. Post-randomization exclusion of 3 patients in the treatment group and 1 patient in the control group who were not included in the analysis. Lost to follow-up: 3 patients in treatment group including 1 patient that did not have outpatient physiotherapy, 1 patient that transferred to a different geographical area, and 1 patient that had an infection requiring surgical revision were lost to follow-up. 1 patient in the control group died. Total losses were approximately 3% of total study population.
Participants	Lincoln County Hospital, United Kingdom N = 120 Inclusion criteria: primary total knee arthroplasty, monoarticular arthrosis, 55 to 90 years old, less than 40° of fixed flexion contracture, walks at least 10 meters unaided. Exclusion criteria: concurrent hip or ankle problem Sex: 37% male Mean (SD) age, years: treatment: 69 (9.3); Control: 68 (10) Assigned: 59/61 (treatment/control) Assessed: 56/60 (at 1 year)
Interventions	Treatment group received outpatient physiotherapy 4 to 6 times after discharge from the hospital. Control group received no outpatient physiotherapy after discharge from hospital. All patients were given a home exercise protocol to follow after discharge.
Outcomes	Duration of follow-up: 12 months postoperatively Range of motion (ROM) of the knee in degrees measured at time of discharge from hospital (baseline), 3, 6, and 12 months postoperatively.
Notes	Baseline ROM used as a covariate in the statistical analysis. There was a slightly higher baseline ROM in the treatment group vs. control group (98 [SD, 13] vs. 96 [SD, 9]) Unknown if outpatient physiotherapy was home-based or clinic-based
Allocation concealment	B = unsure

Study	Kramer et al., 2003 (23)
Methods	Study Design: randomized controlled trial Method of randomization: not described Assessor blinding: yes Intent-to-treat analysis: yes. Author states that an intent-to-treat analysis was completed in which all patients were analyzed as having remained in their assigned group regardless of whether they completed the study in that group. Study Losses: Author gave reasons for loss to follow-up. 22 patients lost in Group 1 and 15 patients lost to group 2. Total losses were 37/160 patients or 23% or study population.
Participants	University of Western Ontario, London, Ontario, Canada N = 160 Inclusion criteria: primary unilateral total knee arthroplasty due to osteoarthritis, has at least 90° active knee flexion ROM preoperatively, has a functional hip on the operative side, able to follow the home exercise protocol independently, able to give independent informed consent. Exclusion criteria: rheumatoid arthritis, major neurological conditions. Sex: 43% male Mean (SD) age, years: home-based physiotherapy: 68.6 (7.8); clinic-based physiotherapy: 68.2 (6.9) Assigned: 80/80 (home exercise only/home exercise + physiotherapy) Assessed: 58/65 (home exercise only/home exercise + physiotherapy)
Interventions	Two rehabilitation treatment groups: Group 1: home-based exercise program with monitoring phone calls from physiotherapist after discharge from hospital. Patients were instructed to complete common home exercises 3 times daily until week 12 postoperatively and then once daily indefinitely. A physiotherapist called the patient at least twice during weeks 2 and 12 postoperatively to inquire about difficulties with exercises, to stress importance of doing the exercises and provide advice on wound care, scar treatment, and pain control. Patients given contact number to use if they had additional questions. Group 2: clinic-based rehabilitation after discharge from hospital + home-based exercise program. Patients attended an outpatient physiotherapy clinic twice weekly for 1-hour sessions between week 2 and 12 postoperatively. After week 12, a clinic-based rehabilitation continued if their surgeon advised. Patients asked to practice the common home exercises at home 3 times daily on the days they did not attend the clinic and twice daily on the days they did attend the clinic. Both groups received standard postoperatively physiotherapy twice daily for 20 minutes while in the acute care setting. Both groups were given 2 booklets describing the common home exercise program developed for routine total knee arthroplasty rehabilitation at the author's institution. Instructed to practice the home exercises 3 times daily until week 12 postoperatively.
Outcomes	Duration of follow-up: 12 months postoperatively, Knee Society Clinical Rating Scale, Western Ontario and McMaster University Osteoarthritis Index (WOMAC), Medical Outcomes Short Form (SF-36), 6-minute walk test, 30-second stair test, active knee flexion ROM
Notes	None
Allocation concealment	A = clearly yes; sealed envelopes

Study	Worland et al., 1998 (24)
Methods	Study Design: randomized controlled trial Method of randomization: not reported Assessor blinding: yes Intent-to-treat analysis: yes. All 80 patients randomized were included in the analysis. Not sure when randomization occurred. Lost to follow-up: Of the 80 people randomized, no dropouts or withdrawals were reported.
Participants	Health South Medical Center, Richmond, Virginia, United States N = 80 Inclusion criteria: primary total knee arthroplasty Exclusion criteria: not reported Sex: 33.8% male Mean (SD) age, years: continuous passive movement (CPM) + home exercise: 69.1 (7); outpatient home-based physiotherapy + home exercise: 71.3 (10) Assigned: 37/43 (CPM+ home exercise/outpatient home-based physiotherapy + home exercise) Assessed: 37/43 (at 6 months)
Interventions	Patients were randomized after hospital discharge to receive CPM at home or physiotherapy by a therapist in their home. Those randomized to CPM used CPM 3 hours per day on the surgically treated knee for 10 days. Those patients randomized to receive physiotherapy received a visit from the physiotherapist in their home for 1 hour 3 times per week for 2 weeks. The physiotherapist continued with the same physiotherapy program the patient received during the in patient acute care setting. Patients in both groups were instructed to perform exercises on their own. All patients also received the same in-patient physiotherapy program before discharge from the hospital. This included CPM for 2 days and active physiotherapy by a therapist twice daily while in hospital. The mean hospital length of stay was 3.5 days.
Outcomes	Duration of follow-up: 6 months postoperatively Knee flexion (ROM) and flexion contracture measured in degrees as well as the Hospital for Special Surgery scoring system were measured before and after surgery at 2 weeks, 3 months, and 6 months.
Notes	none
Allocation concealment	B = unsure

Study	Beaupre et al., 2004 (27)
Methods	Study Design: randomized controlled trial Method of randomization: Method to generate the randomization sequence not described. Assessor blinding: yes Intent-to-treat analysis: no. Not done for primary outcome but completed for health services data analysis. Lost to follow-up: 14 patients in the treatment group and 8 patients in the control group. Total losses were 17% of the initial randomized study sample.
Participants	From the University of Alberta Hospital, Edmonton, Alberta, Canada N = 131 Inclusion criteria: non-inflammatory arthritis, primary total knee arthroplasty, 40–75 years old, willing to undertake the intervention and attend follow-up visits, understands verbal or written English or has a translator. Exclusion criteria: none reported Sex: 45% male Mean (SD) age, years: treatment group 67 (7); control 67 (6) Assigned: 65/66 (treatment/control) Assessed: 51/58 (treatment/control)
Interventions	Preoperative physiotherapy (treatment): patients received a combined education and exercise program 4 weeks preoperatively. Education program included instruction regarding crutch walking, bed mobility and transfers and postoperative ROM routine. Exercise program included simple exercises with progressive resistance to improve knee mobility and strength. Control group did regular activities of daily living before surgery. All patients recovered in the same hospital and received the standard postoperative mobilization routine of the care pathway at that hospital.
Outcomes	WOMAC, SF-36, knee ROM and strength, health services utilization, cost minimization analysis
Notes	None
Allocation concealment	A = clearly yes; consecutively numbered opaque envelopes used.

Study	**Rodgers et al., 1998 (28)**
Methods	Study Design: randomized controlled trail Treatment allocation: Patient assigned to treatment based on geographical location. Assessor blinding: unlikely. The Hospital for Special Surgery knee scale was administered by the senior investigator or his resident staff. The other outcome measures were administered by a certified physical therapist. Intent-to-treat analysis: no. Withdrawals were described but not included in the analysis. Lost to follow-up: 2/12 (16.7%) patients in the treatment group and 1/11 (9%) patient in the control group.
Participants	N = 23 Inclusion criteria: unilateral primary total knee arthroplasty, osteoarthritis. Exclusion criteria: uncontrolled hypertension, cerebral aneurysm, unstable angina, and contraindications to high intensity physical exertion or testing. Sex: 45% male Mean age (years): 70 (range 63-78) treatment /65 (range 50-83) control Assigned: 12/11(treatment/control) Assessed: 10/10 (treatment/control)
Interventions	Preoperative physiotherapy (treatment group): Patients received physiotherapy under the supervision of a certified physical therapist 3 times per week for 6 weeks before surgery. Programs were individualized according to the patient's abilities and re-evaluated every 3 weeks. Control group: received usual preoperative care. Both groups: received preoperative physical therapy instruction on the usual postoperative exercise protocol. All patients received the same postoperative exercises and gait training with weight bearing on the first postoperative day. All patients received outpatient physical therapy as needed at the discretion of the senior author.
Outcomes	Outcomes were assessed at 6 weeks before surgery (treatment group only) and then preoperatively, 6 weeks, and 12 weeks postoperatively for both groups. Hospital for Special Surgery knee scale, ROM, isokinetic flexion and extension testing, thigh circumference, duration of hospital stay, need for post hospitalization physiotherapy, complication rate, thigh muscle area.
Notes	None
Allocation concealment	C = clearly no.

Study	D'Lima et al., 1996 (13)
Methods	Study Design: randomized controlled trial Method of randomization: a computer generated randomization list was used to assign patients to 1 of 3 treatment groups. Assessor blinding: not reported in study. Intent-to-treat analysis: yes Lost to follow-up: No losses to follow-up reported. However, report states that there were 2 postoperative complications in each group. It is not clear if these patients were removed from the data analysis. Systematic review by Ackerman et al. (26) report no dropouts for this study.
Participants	N = 30 Inclusion criteria: aged over 55 years, primary diagnosis of osteoarthritis or rheumatoid arthritis, lives close to the hospital, having unilateral total knee arthroplasty. Exclusion criteria: cognitive, psychological or language impairment, history of stroke or transient ischemic attack. Sex: 53% male Mean (standard deviation) age in years: 69.5 (6.5)control / 68.5 (4.6) treatment / 71.6 6/6 control group 2. Assigned: 10/10/10 (control group 1/treatment/control group 2) Assessed: assumed as assigned.
Interventions	Three treatment groups: Treatment Group: Patient received a one-on-one physical therapy training program to strengthen the upper and lower extremities an improve knee ROM. Frequency of treatment was 45 minutes, 3 times per week for 6 weeks. Control Group 1: Patient met with a physiotherapist preoperatively for 45 minutes during which they were given printed material describing the postoperative exercise regimen. Patients followed the existing routine postoperative protocol for total joint replacement, which included quadriceps and hamstring setting, straight leg raises, hamstring and heel cord stretching, knee strengthening, sitting and prone knee ROM exercises, and routine precautions. Control Group 2: Patients participated in a 45-minute cardiovascular condition training session, 3 times per week for 6 weeks.
Outcomes	Outcomes measured at 6 and 1 week preoperatively, 3, 12, 24, and 48 weeks postoperatively.
Notes	Two patients in each treatment group experienced complications. It is unclear if these patients were assessed for the duration of the study period or removed from the data. Author was contacted, no reply.
Allocation concealment	B = unsure.

Study	Gocen et al., 2004 (30)
Methods	Study Design: randomized controlled trial Method of randomization: computer program table of random numbers Assessor blinding: yes Intent-to-treat analysis: no. Withdrawals are described but not included in analysis. Lost to follow-up: 1 patient in the treatment group was not operated on because of cardiovascular problems and was withdrawn from the study.
Participants	Department of Orthopedics and Traumatology in a University Hospital, Turkey N = 60 Inclusion criteria: osteoarthritis of the hip, having a total hip replacement, with a thrust plate prosthesis and cementless acetabular component, has not had previous physiotherapy for osteoarthritis of the hip. Exclusion criteria: chronic disease, arthritis of other joints necessitating treatment. Sex: 64% male Mean (SD) age, years: treatment group 46.9 (11.5); control group 55.5 (14.4) Assigned: 30/30 (treatment/control) Assessed: 29/30 (treatment/control)
Interventions	Preoperative physiotherapy (treatment group): patients received a combined exercise and education program 8 weeks before surgery. During the education session advice on movement to avoid postoperatively, use of devices, posture, lifting and carrying, washing and bathing was given. Exercise program included straight leg raises, stretching of the hamstrings, hip flexors and upper and strengthening of the upper extremities were performed 3 times per day at a frequency of 10 repetitions each time. Control group did regular activities before surgery. Activity not specified. Both groups received the same postoperative physiotherapy and education program beginning postoperative day 1.
Outcomes	Harris Hip Score, pain visual analogue scale score, ROM of the hip, recorded the day patient started walking, climbing stairs, and transferring.
Notes	Multiple Student's t-tests between groups at each time undertaken in statistical analysis.
Allocation concealment	0 = clearly no. Even randomization numbers were allocated to the control group and odd randomization numbers to the study group.

Study	Gilbey et al., 2003 (29)
Methods	Study Design: randomized controlled trial Method of randomization: not reported Assessor blinding: no Intent-to-treat analysis: no. The author describes withdrawals but does not include them in the analysis. Lost to follow-up: 76 patients were recruited. 6 surgeries were cancelled because of medical reasons and 2 patients in the treatment (preoperative exercise) group chose to postpone surgery after completion of the presurgery exercise program. 5 patients in the treatment group and 6 patients in the control group were not assessed after surgery because of social or clinical reason. Therefore 11/68 subjects that had surgery or 16% of the study population were lost to follow-up.
Participants	N = 76 Inclusion criteria: osteoarthritis, post traumatic arthritis, inflammatory arthritis, osteonecrosis, Paget's disease of the hip, chronic pain and disability, unresponsive to conservative treatment, stable health, fit for anesthesia. Exclusion criteria: history of infection in the hip, significant neuromuscular disease, malignancy in hip area, poor general health, hip revision surgery or bilateral hip replacements. Sex: 38.2% male Mean (SD) age, years: treatment group 66.73 (10.19); control 63.29 (12.01) Assigned: 37/31 (treatment/control) Assessed: 32/25 (treatment/control)
Interventions	Preoperative physiotherapy (treatment group): patients were required to perform 2 1-hour supervised clinic-based sessions and 2 home-based sessions each week for 8 weeks before surgery. All subjects returned to a supervised clinic and home-based exercise program beginning at week 3 postoperatively and continuing until week 12 postoperatively. All exercise programs were individualized to the patient's level of pain, age, and general physical ability. Clinic sessions included hydrotherapy, stationary bike riding, and use of resistive training machines to increase strength. Home exercises consisted of further muscle strengthening using ankle weights, dumbbells, and a series of flexibility exercises. Control group: received no supervised or structured exercises other than the advice routinely provided by the hospital physiotherapist.
Outcomes	Outcome assessments completed at 8 weeks and 1 week before surgery and 3, 12, and 24 weeks after surgery. Strength of bilateral thigh flexor and extensor muscles, isometric thigh abduction strength, hip flexion ROM, WOMAC, patient satisfaction.
Notes	Patients became familiar with the exercise procedures before random allocation was made to the treatment or control groups.
Allocation concealment	1 = not sure. Allocation concealment not described in the report.

Appendix 3: Characteristics of Excluded Studies

Study	Reason for exclusion	Characteristic of study
Berge et al., 2004 (37)	Preoperative educational pain management only No preoperative exercise training	RCT of 40 patients having total hip replacement. The aim of the study was to evaluate a multidisciplinary pain management program preoperatively for patients waiting for total hip replacement compared with wait-list control subjects.
Berger et al., 2004 (38)	Case series	Case series of 100 consecutive patients prospectively enrolled in a rehabilitation protocol for a minimally invasive surgical technique for total hip arthroplasty.
Brandis et al., 1998 (39)	Descriptive report	This report presents the conceptual framework, activities, and outcomes of and interdisciplinary model of care for orthopedic patients.
Cheville et al., 2001 (40)	Comparison of time-release oxycodone compared with placebo in the acute care setting after total joint rehabilitation	RCT of controlled release oxycodone or placebo every twelve hours. Pain ratings as determined with a VAS, changes in ROM of the knee and quadriceps strength, and improvements in selected Functional Independence Measure scores during the first 9 physical therapy sessions. Duration of hospitalization for rehabilitation was also compared between groups.
Crowe et al., 2003 (41)	Study involved therapies other than physiotherapy; 52% of study population received a variety of preoperative physiotherapy exercise programs.	RCT of 133 patients having hip or knee arthroplasty were treated preoperatively with an individually tailored multidisciplinary rehabilitation program or given usual care consisting of a single preoperative visit.
Ganz et al., 2003 (42)	Case series	A case series report to evaluate the day of discharge and its relation to the milestones of rehabilitation after total hip arthroplasty.
Heaton et al., 2000 (43)	Descriptive study	Qualitative study examining the effectiveness of rehabilitation therapies for primary elective total hip arthroplasty patients from the patient perspective.
Hypnar et al., 2001 (44)	Descriptive research	A description of a joint care program and its outcomes including length of stay, complications, functional status, discharge disposition to home and costs per case.
Jan et al., 2004 (45)	Study treatment happened more than 1 month after surgery	RCT of 53 patients who had primary total hip replacement 1.5 years before study treatment Purpose of study was to evaluate the efficacy of a home exercise program in improving hip muscle strength, walking speed, and functional ability
Kane et al., 2000 (46)	Nature of surgery (primary or revision) not reported	Study purpose was to estimate the difference in functional outcomes attributable to discharge to 1 of 4 difference venues for post hospital care for each of 5 types of illness including hip procedures.

Study	Reason for exclusion	Characteristic of study
MacLeod et al., 1998 (47)	Descriptive study	Descriptive study and program evaluation of a subacute model of care for patients after primary joint replacement offered at The Orthopaedic and Arthritic Institute, Toronto, Ontario.
McDonald et al., 2004 (48)	Education treatment only	Systematic review of preoperative education programs for persons undergoing knee and hip arthroplasty. Education programs do not include a physiotherapy exercise-training component.
Ranawat et al., 2003 (49)	Case series report of rehabilitation for painful total knee arthroplasty	scribes and evaluates a postoperative rehabilitation management program for 181 patients.
Rivard et al., 2003 (50)	Study treatment is an education treatment and preoperative assessment only	Non-RCT of 208 patients having a total hip replacement who received a preoperative home visit from an occupational therapist within 1 to 2 weeks before surgery compared with those who received rehabilitation teaching from an occupational therapist in a group setting at a hospital preadmission clinic 1 to 2 weeks before surgery.
Rorabeck et al., 1999 (51)	Letter	Opinion article on continuous passive motion
Sashika et al., 1996 (52)	25% of study population was undergoing total hip arthroplasty revision	Non-RCT with control group of 23 patients who had a primary total hip arthroplasty or a revision were treated with 1 or 2 home-based exercise programs or a control group that did not receive any home exercise program.
Shepperd et al., 1998 (53)	Nature of surgery (primary or revision) not reported	RCT of 172 patients having knee or hip arthroplasty and randomized to hospital at home scheme or hospital care. Health outcomes and costs were evaluated for each treatment group.
Spalding et al., 1995 (54)	Education program only	41 patients having primary total hip replacement were treated with a preoperative education program presented by an occupational therapist and a physiotherapist, an anesthetist, orthopedic nurse, and a dietician compared with those who did not attend such a program. Content of the educational program included what to expect of admission, surgery, and rehabilitation and how to prepare for discharge.
Trudelle-Jackson et al., 2004 (55)	Unknown if replacements were primary or revisions Study intervention happened more than 1 month after surgery.	34 patients who underwent total hip arthroplasty 4 to 12 months before study intervention. The purpose of the study was to investigate the efficacy of a late-phase rehabilitation program initiated 4 to 12 months after total hip arthroplasty.
Unver et al., 2002 (56)	Compares 2 rehabilitation programs during postoperative acute care phase of recovery	RCT of patients having total hip arthroplasty were randomly assigned to receive an accelerated rehabilitation program with early

Study	Reason for exclusion	Characteristic of study
		partial weight bearing or early full weight bearing starting on the first postoperative day.
Weaver et al., 2003 (57)	Comparison of 2 home care treatment protocols involving teaching and patient instruction only	An RCT of home care protocol that included preoperative home visits by a nurse and a physical therapist fewer postoperative visits (9–12 visits) to the home than an existing protocol (11–47 visits).

Appendix 4: The Cochrane Musculoskeletal Injuries Group Methodological Assessment Tool.

This assessment tool has been developed by the Cochrane Collaboration Musculoskeletal Injuries Group. It includes aspects of internal and external validity. Individual scores for each item are derived and a total score is optional and may be obtained by summing the scores of individual items. The scores for the last 3 items used in the total score are those for the primary measure of the systematic review. The scoring sheet indicates items that need further review. In cases where the items remain unknown, all items are designated the lowest score except for allocation concealment where the middle score is given. The scoring criteria are detailed below:

A. Was the assigned treatment adequately concealed prior to allocation?
   2=method did not allow disclosure of assignment.
   1=small but possible chance of disclosure of assignment or unclear.
   0=quasi-randomized or open list/tables.
   Cochrane code: Clearly Yes=A; Not sure=B; Clearly No=C

B. Were the outcomes of patients/participants who withdrew described and included in the analysis (intention-to-treat)?
   2=withdrawals well described and accounted for in analysis.
   1=withdrawals described and analysis not possible.
   0=not mentioned or not possible.

C. Were the outcome assessors blinded to treatment status?
   2= effective action taken to blind assessors.
   1= small or moderate chance of unblinding of assessors.
   0= not mentioned or not possible.

D. Were the treatment and control group comparable at entry?
   2= good comparability of groups, or confounding adjusted for in analysis.
   1=confounding small; mentioned but not adjusted for.
   0= large potential for confounding, or not discussed.

E. Were the participants blind to assignment status after allocation?
   2=effective action taken to blind participants.
   1=small or moderate chance of unblinding of participants.
   0= not possible, or not mentioned (unless double-blinded), or possible but not done.

F. Were the treatment providers blind to assignment status?
   2=effective action taken to blind treatment providers.
   1=small or moderate chance of unblinding of treatment providers.
   0=not possible, or not mentioned (unless double-blinded), or possible but not done.

G. Were care programs, other than the trial options, identical?
   2=care programs clearly identical.
   1=clear but trivial differences.
   0=not defined.

H. Were the inclusion and exclusion criteria clearly defined?
2=clearly defined.
1=inadequately defined.
0=not defined.

I. Were the interventions clearly defined? (This item was optional)
2=clearly defined interventions are applied with a standardized protocol.
1=clearly defined interventions are applied but the application protocol is not standardized.
0= intervention and/or application protocol are poorly or not defined.

J. Were the outcome measures used clearly defined (by outcome)
2=clearly defined.
1=inadequately defined.
0=not defined.

K. Were diagnostic tests used in outcome assessment clinically useful? (by outcome)
2=optimal.
1= adequate.
0=not defined, not adequate.

L. Was the surveillance active and clinically appropriate duration? (by outcome)
2=active surveillance and appropriate duration.
1=active surveillance, but inadequate duration.
0=surveillance not active or not defined.

Appendix 5: Inpatient Rehabilitation Beds Staffed and in Operation 2003/2004

	Name	Type	Beds
1	BARRIE ROYAL VICTORIA HOSPITAL	General Rehab	15
2	BELLEVILLE QUINTE HEALTHCARE CORP-BELLEVILLE GENERAL SITE	General Rehab	17
3	BRAMPTON WILLIAM OSLER HLTH CTR-GEORGETOWN SITE	General Rehab	25
4	BRANTFORD GENERAL HOSPITAL	General Rehab	25
5	BROCKVILLE PROVIDENCE CONTINUING CARE CENTRE-ST VINCENT DE PAUL SITE	General Rehab	5
6	BURLINGTON JOSEPH BRANT MEMORIAL	General Rehab	30
7	CHATHAM ST JOSEPH'S HEALTH SERVICES ASSOCIATION OF CHATHAM INCORPORATED	General Rehab	23
8	COBOURG NORTHUMBERLAND HILLS HOSPITAL	General Rehab	18
9	CORNWALL GENERAL HOSPITAL	General Rehab	22
10	GUELPH GENERAL HOSPITAL	General Rehab	12
11	GUELPH ST JOSEPH'S HEALTH CENTRE GUELPH	General Rehab	10
12	HAMILTON ST JOSEPH'S HLTH CARE SYS-HAMILTON	General Rehab	29
13	HAMILTON HEALTH SCIENCES CORP-GENERAL SITE	General Rehab	16
14	HAMILTON HEALTH SCIENCES CORP-HENDERSON SITE	General Rehab	60
15	KINGSTON GENERAL HOSPITAL	General Rehab	10
16	KINGSTON PROVIDENCE CONTINUING CARE CENTRE-ST MARY OF THE LAKE SITE	General Rehab	46
17	KITCHENER GRAND RIVER HOSPITAL CORP-FREEPORT HOSPITAL SITE	General Rehab	32
18	KITCHENER GRAND RIVER HOSPITAL CORP-WATERLOO	General Rehab	9

	Name	Type	Beds
	HOSPITAL SITE		
19	KITCHENER ST MARY'S GENERAL	General Rehab	15
20	LEAMINGTON DISTRICT MEMORIAL	General Rehab	6
21	LONDON ST JOSEPH'S HEALTH CARE LONDON	General Rehab	79
22	MARKHAM STOUFFVILLE HOSPITAL	General Rehab	16
23	MISSISSAUGA THE CREDIT VALLEY HOSP	General Rehab	42
24	MISSISSAUGA TRILLIUM HEALTH CENTRE-MISSISSAUGA HOSPITAL SITE	General Rehab	74
25	NEWMARKET SOUTHLAKE REGIONAL HEALTH CENTRE	General Rehab	28
26	NORTH BAY GENERAL HOSPITAL-ST JOSEPH'S SITE	General Rehab	10
27	OAKVILLE HALTON HEALTHCARE SERV-TRAFALGAR MEMORIAL SITE	General Rehab	35
28	OSHAWA LAKERIDGE HEALTH CORPORATION-OSHAWA GENERAL SITE	General Rehab	49
29	OTTAWA SISTERS OF CHARITY OF OTTAWA	General Rehab	98
30	OTTAWA THE OTTAWA HOSPITAL-CIVIC SITE	General Rehab	28
31	OWEN SOUND GREY BRUCE HLTH SERV-GREY BRUCE SITE	General Rehab	16
32	PEMBROKE GENERAL HOSPITAL	General Rehab	22
33	PENETANGUISHENE GENERAL HOSPITAL	General Rehab	15
34	PETERBOROUGH REGIONAL HEALTH CENTRE	General Rehab	29
35	RICHMOND HILL YORK CENTRAL	General Rehab	32
36	SARNIA BLUEWATER HEALTH-SARNIA GENERAL SITE	General Rehab	27
37	SAULT STE MARIE SAULT AREA HOSPITAL	General Rehab	23
38	ST CATHARINES NIAGARA HLTH SYS-ST CATHARINES SHAVER SITE	General Rehab	22

	Name	Type	Beds
39	ST THOMAS-ELGIN GENERAL HOSPITAL	General Rehab	10
40	STRATFORD GENERAL HOSPITAL	General Rehab	15
41	THUNDER BAY ST JOSEPH'S CARE GROUP	General Rehab	25
42	TOR BAYCREST HOSPITAL NY	General Rehab	32
43	TOR BRIDGEPOINT HOSPITAL	General Rehab	112
44	TOR EAST GENERAL HOSPITAL	General Rehab	13
45	TOR HUMBER RIVER REGIONAL HOSPITAL-HUMBER MEMORIAL SITE	General Rehab	18
46	TOR NORTH YORK GENERAL	General Rehab	15
47	TOR ROUGE VALLEY HEALTH SYSTEM - AJAX & PICKERING SITE	General Rehab	20
48	TOR ROUGE VALLEY HEALTH SYSTEM - CENTENARY SITE	General Rehab	20
49	TOR SCARB PROVIDENCE HEALTHCARE	General Rehab	87
50	TOR SCARBOROUGH HOSPITAL - SALVATION ARMY GRACE SITE	General Rehab	7
51	TOR SCARBOROUGH HOSPITAL - SCARBOROUGH GEN. SITE	General Rehab	19
52	TOR ST JOHN'S REHABILITATION HOSPITAL	General Rehab	148
53	TOR ST JOSEPH'S HEALTH CENTRE	General Rehab	10
54	TOR SUNNYBROOK AND WOMEN'S COLLEGE - SUNNYBROOK SITE	General Rehab	8
55	TOR SUNNYBROOK AND WOMEN'S COLLEGE HEALTH SCIENCES - ORTHOPAEDIC & ARTHRITIC SITE	General Rehab	22
56	TORONTO REHABILITATION INSTITUTE - HILLCREST SITE	General Rehab	180
57	WINDSOR HOTEL DIEU GRACE HOSPITAL - HOTEL DIEU OF ST JOSEPH'S SITE	General Rehab	24
58	WINGHAM AND DISTRICT HOSPITAL	General Rehab	5

	Name	Type	Beds
59	HAMILTON HEALTH SCIENCES CORP-CHEDOKE SITE	Special Rehab	60
60	LONDON ST JOSEPH'S HEALTH CARE LONDON	Special Rehab	40
61	OTTAWA THE OTTAWA HOSPITAL - THE REHABILITATION CENTRE SITE	Special Rehab	73
62	SUDBURY HOPITAL REGIONAL DE SUDBURY-LAURENTIAN SITE	Special Rehab	21
63	THUNDER BAY ST JOSEPH'S CARE GROUP	Special Rehab	25
64	TOR BLOORVIEW MACMILLAN CENTRE	Special Rehab	41
65	TOR ST JOHN'S REHABILITATION HOSPITAL	Special Rehab	6
66	TOR WEST PARK HEALTHCARE CENTRE	Special Rehab	127
67	TORONTO REHABILITATION INSTITUTE - LYNDHURST SITE	Special Rehab	60
68	WINDSOR REGIONAL HOSPITAL - WESTERN SITE	Special Rehab	49

Finance and Information Management Branch's Daily Census Summary.

Appendix 6: Designated Physiotherapy Outpatient Clinics

SCHEDULE OF DESIGNATED PHYSIOTHERAPY CLINICS-APRIL 1, 2005

1. Aurora Coxwell Physiotherapy Centre, 126 Wellington Street W, #201, Aurora, ON L4G 2N9 (905) 841-7126
2. Barrie Barrie Physiotherapy Clinic, 125 Bell Farm Road, Suite 104, Barrie ON L4M 2K9 (705) 725-1980
3. Belleville Quinte Physiotherapy Clinic, 235 Bridge Street E, Belleville ON K8N 1P2 (613) 962-9096
4. Bramalea Evans Physiotherapy Clinic, 40 Finchgate Blvd., Suite 109, Bramalea ON L6T 3J1 (905) 792-2312
5. Brampton North Brampton Physiotherapy, 36 Vodden Street E, Brampton, ON L6V 4H4 (905) 455-7744
6. Brantford Greystone Physiotherapy Clinic, 325 West Street, Bldg A, Brantford ON N3R 6B7 (519) 756-5450
7. Brantford Scott Physiotherapy Clinic, 35 Morrell Street, Brantford ON N3T 4J3 (519) 759-2155
8. Brechin Mr. B. MacIntyre, 476 West St. N, Orillia, ON L3V 5E8 (705) 327-1433
9. Burlington Brant 730 Physiotherapy, 730 Brant Street, Burlington ON L7R 2H9 (905) 632-1734
10. Cambridge The Harrington Physiotherapy Clinic, 39 Grand Ave. N, Cambridge ON N1S 2K7 (519) 621- 3035
11. Cornwall Cornwall Physiotherapy Clinic, 25 Cumberland Street, Cornwall, ON K6J 4G8 (613) 932-2447
12. Durham Bluewater Physiotherapy Clinic, 145 Saddler Street E., Durham ON N0G 1R0 (519) 369-2334
13. Etobicoke Four Seasons Physiotherapy, 16 Four Seasons Place, Etobicoke ON M9B 6E5 (416) 621-8873
14. Etobicoke Kingsway Physiotherapy, 2917 Bloor Street W., M8X 2W2 (416) 233-6368
15. Etobicoke Mrs. M. J. Howell, 160 Royalavon Cr., Etobicoke, ON M9A 2G4 (416) 231-4732
16. Etobicoke Queensway Physiotherapy Centre, 1255 The Queensway, #5a , Etobicoke, ON M8Z 1S1 (416) 251-5400
17. Etobicoke Six Points Physiotherapy, 5468 Dundas Street W., Unit 106, Etobicoke ON M6B 6E3 (416) 239-3323
18. Guelph Stone Road Mall Physiotherapy, 435 Stone Road W., Suite 205, Guelph ON N1G 2X6 (519) 822-2435
19. Hamilton First Place Physiotherapy, 397 Main Street E., Hamilton, ON L8N 1J7 (905) 525-2683
20. Hamilton Mountain Physiotherapy, 520 Upper Sherman, Hamilton, ON L8V 3L8 (905) 389-0143
21. Hamilton Park Physical Therapy, 210 Mowhawk Rd E., Hamilton, ON L9A 2H6 (905) 575-7505
22. Hamilton Physiotherapy Services, 104-280 Queenston Rd. Hamilton, ON L8K 1H1 (905) 544-0053
23. Hamilton 68 Charlton Avenue West Ltd., 68 Charlton Ave. W., Hamilton, ON L8P 2C1 (905) 528-5271
24. Hamilton Steel City Physiotherapy, 50 Dundurn St. S., Hamilton ON L8P 4W3 (905) 527-2606
25. Hamilton The Hamilton Physiotherapy Clinic, 200 James St. S., Suite 207, Hamilton ON L8P 3A9 (905) 529-0521
26. Hamilton Upper Ottawa Physiotherapy, 883 Upper Wentworth Street, #305, Hamilton, ON L9A 4Y6 (905) 389-8772
27. Hamilton West End Physiotherapy Clinic, 10 Ewen Rd, Hamilton, ON L8S 3C4 (905) 524-2365
28. Kingston Blaser's Physiotherapy Clinic, 321 Concession St., #202, Kingston, ON K7K 2B9 (613) 542-3852
29. Kitchener Kitchener Physiotherapy Centre, 386 Gage Avenue, Kitchener, ON N2M 5C9 (519) 742-5482

30. Lindsay Lindsay Physiotherapy Services, 86 Angeline Street S., Lindsay ON K9V 6C5 (705) 324-8512
31. London Mr. J. Salo, 1151 Glenora Dr., London ON N5X 2R4
32. London The London Physical Therapy Clinic, 561 Dundas St., Suite 101, London ON N6B 1X1 (519) 433-6113
33. Maple Mr. D. Creighton, 3 Naylon Street, Maple ON L6A 1R8 (905) 832-1101
34. Midland Mrs. M. Thomson, 9226 #93 Hwy, Box 16, Midland ON L4R 4K3 (715) 528-0044
35. North York Canadian Physiotherapy Centre, 2175 Sheppard Ave. E., #104 , North York, ON M2J 1W8 (416) 493-0703
36. North York Lawrence Curlew Physiotherapy, 1236 Lawrence Ave. E., North York, ON M3A 1B9 (416) 447-1457
37. North York Kinesis Physical Therapy, 1170 Wilson Ave, North York, ON M3M 1H3 (416) 638-7744
38. North York Freda Naiman Physiotherapy, 3333 Bayview Ave, #302, North York, ON M2K 1G4 416) 223-0375
39. North York North East Physiotherapy Services, 500 Sheppard Ave E., #100, North York, ON M2N 6H7 (416) 512-8888
40. North York North Toronto Physiotherapy Centre, 368 Melrose Ave., North York, ON M5M 1Z7 (416) 789-5936
41. North York Physiotherapy Associates, 20 Wynford Drive, #112, North York, ON M3C 1J4 (416) 441-1222
42. North York The Physiotherapy Centre, 120 Overlook Place, #104, North York, ON M3H 4P8 (416) 631-7797
43. North York Willowdale Physiotherapy Clinic, 6228 Yonge Street, Suite S-2, North York, ON M2M 2X4 (416) 226-2402
44. Oakville Oakville Physiotherapy Centre, 101 Maurice Drive, Oakville, ON L6K 2W6 (905) 845-6922
45. Oshawa Central Park Physiotherapy Centre, 299 Simcoe Street S., Oshawa, ON L1H 4H5 (905) 725-4241
46. Oshawa Mr. G. F. Monckton, 21 Gladstone Ave., Unit 102, Oshawa, ON L1J 4E3 (905) 725-8359
47. Oshawa Clinic, 29 Charles Street, Oshawa, ON L1H 4X5 (905) 723-8551
48. Ottawa Mrs. A. G. Arnold, 2197 Riverside Dr. Suite 110, Ottawa, ON K1H 7X3 (613) 731-7917
49. Ottawa Cleave Physiotherapy, 180 Metcalfe St. Suite 104, Ottawa, ON K2P 1P5 (613) 234-9970
50. Ottawa The Sports Therapy Clinic, 1125 Colonel By Dr., Ottawa, ON K1S 5B6 (613) 520-3511
51. Ottawa Regional Physiotherapy Clinic, 1443 Woodroffe Ave, Ottawa, ON K2G 1W1 (613) 224-4332
52. Ottawa The Ottawa and District Physiotherapy Clinic, 301 Metcalfe Street, Ottawa, ON K2P 1R9 (613) 233-1235
53. Pembroke Pembroke Physiotherapy Clinic, 171 Maple Ave, Pembroke, ON K8A 1L3 (613) 732-8020
54. Sarnia Lambton County Physiotherapy Services, 463 Christina St. N, Sarnia ON N7T 5W3 (519) 336-0588
55. Sarnia Sam Shuqair Physiotherapy, 225 Davis Street, Sarnia, ON N7T 1B2 (519) 344-7581
56. Sault Ste. Marie Sault Physiotherapy Centre, 451 Queen Street E. Sault Ste. Marie ON P6A 5L2 (705) 945-9600
57. Sault Ste. Marie Sault Ste. Marie & District Group Health Association, 240 McNabb St, Sault Ste. Marie ON P6B 1Y5 (705) 759-1234
58. Scarborough Central Scarborough Physiotherapy Clinic, 2155 Lawrence Ave E., Toronto, ON M1R 5G9 (416) 755-0879
59. Scarborough Scarborough-South Physiotherapy Centre, 3481 Kingston Rd. Scarborough, ON M1M 1R4 (416) 266-8844
60. Scarborough Yee Hong Rehabilitation Centre, 2311 McNicholl Ave., Scarborough ON M1V 5L3 (416) 298-2278

61. Scarborough Miss M. W. Seaver, 1121 Bellamy Rd N, Scarborough, ON M1H 3B9 (416) 438-5195
62. Simcoe Elgin Ave. Physiotherapy, 2 Elgin Avenue, Simcoe ON N3 Y 4A8 (519) 426-2642
63. Stoney Creek Queenston Physiotherapy, 15 Mountain Ave. S. #105, Stoney Creek ON L8G 2V6 (905) 662-2011
64. Stouffville Stouffville Physiotherapy Clinic, 37 Sandiford Dr. Suite 103, Stouffville ON L4A 7X5 (905) 640-1818
65. Thorold Thorold Medical Clinic, 60 Albert Street W., Thorold ON L2V 2G7 (905) 227-5255
66. Tillsonburg Tillsonburg Physiotherapy Clinic, 171 North Street E. Tillsonburg ON N4G 1B8 (519) 842-5162
67. Toronto Albany Physiotherapy Clinic, 200 Danforth Ave., Toronto, ON M4K 2N5 (416) 461-9471
68. Toronto Bloor Medical Clinic, 500-2065 Finch Ave W. Toronto ON M3N 2V7 (416) 747-5128
69. Toronto Davisville Physiotherapy Centre, 1835 Yonge Street, Suite 303, Toronto, ON M4S 1X8 (416) 489-5313
70. Toronto Eglinton-Bayview Physiotherapy (PATH), 544 Eglinton Ave E, Toronto, ON M4P 1N9 (416) 489-8888
71. Toronto Mrs. M. Gacich, 2238 Dundas St. W. Suite 112, Toronto, ON M6R 3A9 (416) 531-5055
72. Toronto High Park Physiotherapy, 2150 Bloor St. W. Suite 301, Toronto, ON M6S 1M8 (416) 766-8565
73. Toronto Community Physiotherapy Clinic, 1101 Queen Street E., Toronto, ON M4M 1K7 (416) 465-2401
74. Toronto Miss D. Madgett, 123 Edward Street, Suite 1124, Toronto, ON M5G 1E2 (416) 340-7070
75. Toronto Main & Gerrard Physiotherapy Clinic, 194 Main Street, Toronto, ON M4E 2W1 (416) 691-4835
76. Toronto Parkdale Physiotherapy Associates, 750 Dundas St W, Suite 310, Toronto ON M6J 3S3 (416) 815-1067
77. Toronto Physical Therapy Services, 484 Church Street, Suite 109, Toronto, ON M4Y 2C7 (416) 923-8577
78. Toronto Physiotherapy Ki Li, 688 Coxwell Ave., Suite 316, Toronto, ON M4C 3B7 (416) 461-5200
79. Toronto Kings Professional Physiotherapy Clinic, 1209 King Street W. Suites 3&4, Toronto, ON M6K 1G2 (416) 588-9377
80. Toronto Brenda L. Rusnak, 1500 Bathurst Street, Suite 6, Toronto ON M5P 3L3 (416) 651-0824
81. Toronto St. Clair-Dufferin Medical Centre, 2045 Dufferin Street, Toronto ON, M6E 2R4 (416) 651-1210
82. Toronto Scarborough North Physiotherapy Clinic, 3443 Finch Ave E. #407, Toronto ON M1W 2S1 (416) 499-6635
83. Toronto Mrs. Hanna Scheutze, 142 Close Ave., Toronto ON M6K 2V5 (416) 534-7588
84. Toronto St. George Physiotherapy Clinic, 208 Bloor St. W. #601-602, Toronto ON M5S 3B4 (416) 921-4587
85. Toronto Shelton Physiotherapy Associates, 2468 Eglinton Ave. W Unit 2, Toronto ON M6M 5E2 (416) 651-1722
86. Waterdown King East Physiotherapy, 5-80 Hamilton St N, Waterdown ON L0R 2H6 (905) 690-1033
87. Welland Physiotherapy Rehabilitation Centre, 17 Vaughn Rd., Welland ON L3B 5Z7 (905) 788-1985
88. Weston Weston Physiotherapy Centre, 1730 Weston Rd. Toronto ON M9N 1V6 (416) 247-3291
89. Windsor Joseph Berkeley Ltd., 1720 Howard Ave, Suite 159, Windsor ON N8X 5A6 (519) 253-7259
90. Windsor Windsor Physiotherapy Services, 280 Edinborough St, #4, Windsor ON N8X 3C4 (519) 250-8777
91. Windsor Wardle's Physiotherapy Clinic, 960 Tecumseh Rd E., Windsor ON N8X 2S6 (519) 252-2753
92. York York Physiotherapy and Rehabilitation Centre, 977 Eglinton Ave W. Toronto ON M6C 2C4 (416) 781-3945

93. York Humber Physiotherapy Services, 1436 Royal York Rd, #106, Toronto ON M9P 3A9 (416) 245-4155
94. York Professional Physiotherapy Centre, 2100 Lawrence Ave W., #201, Toronto ON M9N 3W3 (416) 241-2321

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